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PHYSICS ABSTRACTS

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Physics Abstracts

SECTION A OF SCIENCE ABSTRACTS

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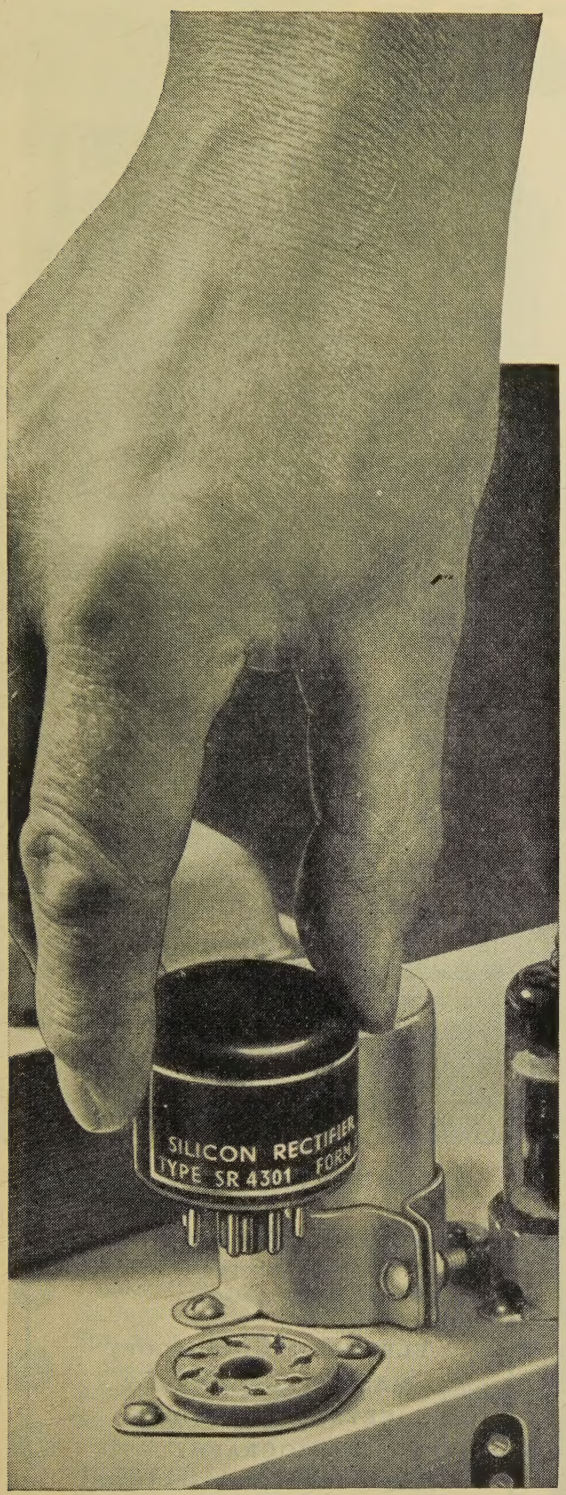

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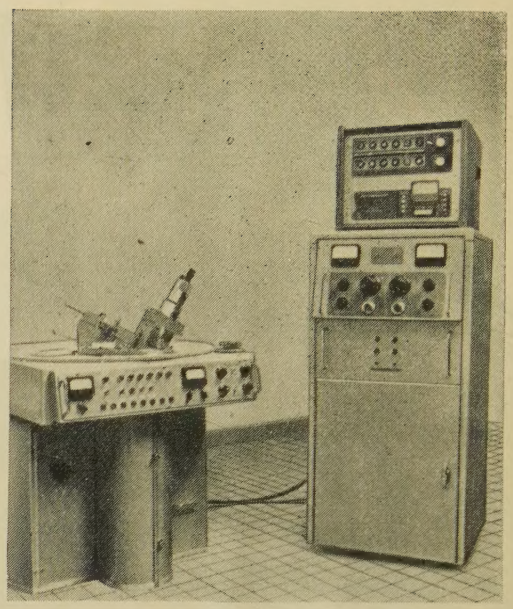

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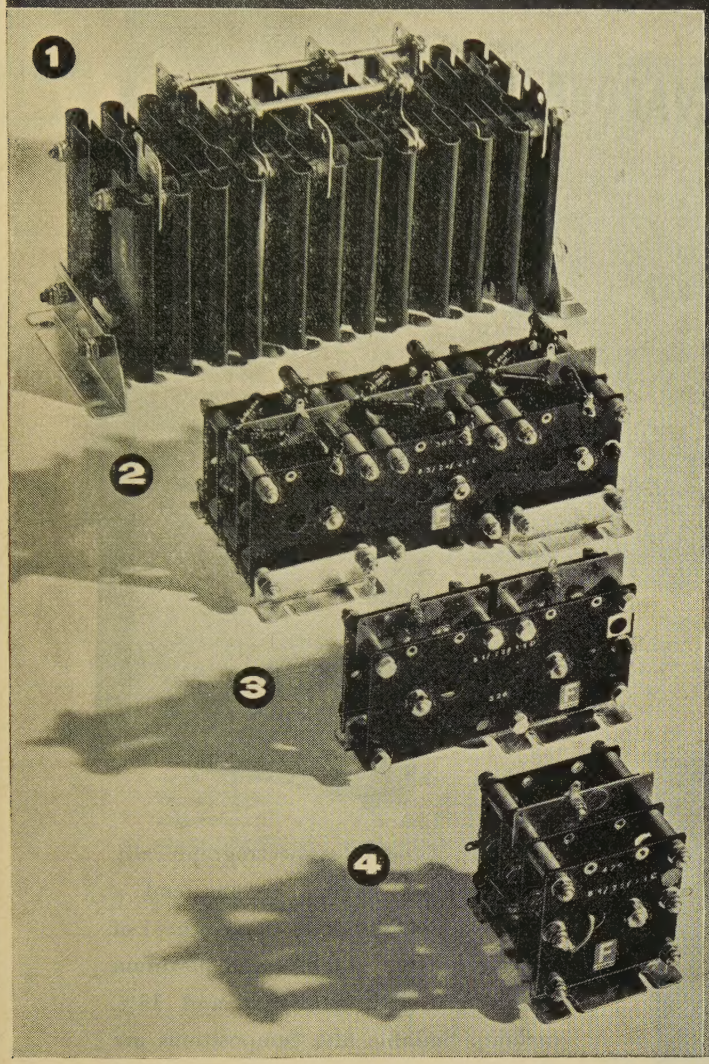

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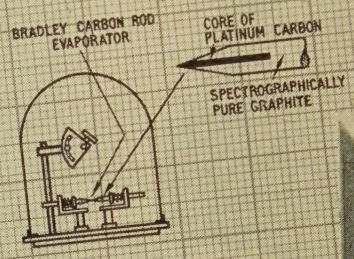

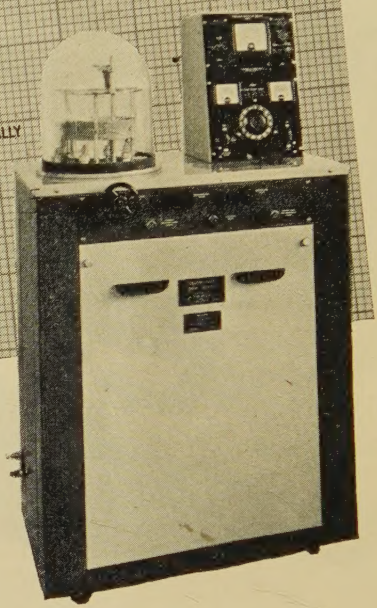

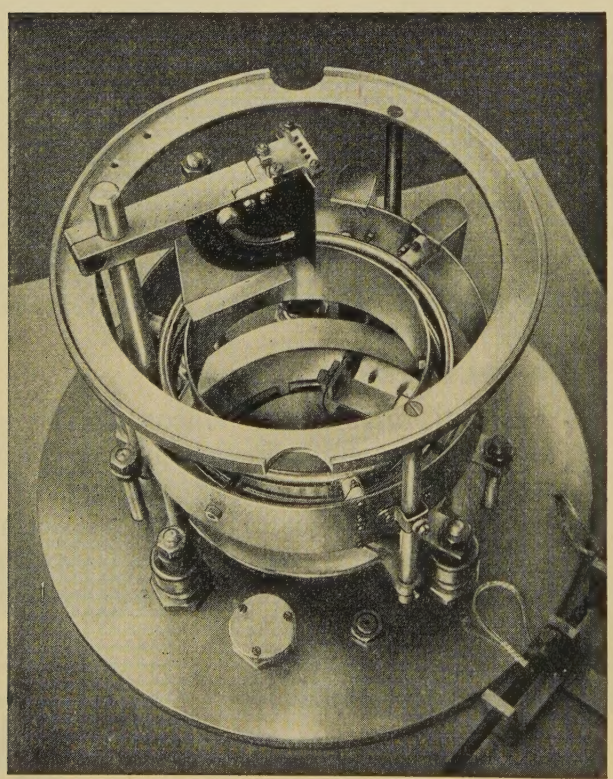

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† Hilliard, A., Holland, L., Siddall, G. Brit. Pat. Appl. No. 1753/59.

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PHYSICS ABSTRACTS

Volume 63 JANUARY 1960 Number 745

With this issue of "Physics Abstracts", which commences Volume 63, some changes have been made in the arrangement of the abstracts. The full list of the "chapters" into which the abstracts are divided is printed inside the front cover, and it will be seen by comparing this with the last volume that some new headings have been introduced, some of the old ones have been modified, and the order of the chapters partly rearranged.

The major innovation is the rearrangement and expansion of the section entitled "Solid-State Physics", in line with the rapid expansion of this field and the wide variety of investigations which it embraces. A feature of modern work on the solid state is the way in which formerly unrelated physical properties of solids are being shown to have common causes, and the practice of grouping abstracts on the various properties of solids under the traditional headings of classical physics is becoming obsolete. In the new arrangement, therefore, studies on solids which were formerly placed under the headings "Optics", "Electric Conduction", "Magnetism", etc., have now (when they are seen to be really studies of the solid state rather than of the physical phenomenon) been brought together under "Solid-State Physics", together with "Crystallography" and "Mechanical Properties" (elasticity, etc.). This arrangement is inevitably experimental in many respects, and some modification and evolution is to be expected; readers are invited to cooperate in this, and their comments and advice will be very welcome.

Those of our readers who are familiar with the Universal Decimal Classification system will note that the chapters are no longer arranged strictly in U.D.C. order, though the departures are not very serious. It was felt that strict adherance to the U.D.C. order, which has been the basis for the arrangement of abstracts in "Physics Abstracts" for the past eighteen years, was no longer serving a useful purpose, when so many new subjects are not yet included in the U.D.C., and the grouping of subjects is in some respects out of line with the development of modern physics. For the benefit of any who use the U.D.C. to file away individual abstracts, classification numbers will still be allotted to each abstract, and the abstracts within each chapter will be arranged in numerical order. A great degree of detail will not be supplied in the classification, however, as this is invariably affected by the individual requirements of any specialist reference file and is best supplied by the compiler himself. Comments on the value to users of these U.D.C. classification numbers will be welcome.

ASTROPHYSICS

522.6

1 ON THE REDUCTION OF POLARIZATION MEASURES AFFECTED BY INSTRUMENTAL POLARIZATION. A.J. Wesselink.
Monthly Not. Roy. Astron. Soc., Vol. 118, No. 3, 271-5 (1958).

The effect of oblique reflection on measures of polarization has been studied. Simple formulae are derived whereby observations of stars whose polarizations are known can be used to calibrate observations subject to oblique reflection. The method is illustrated by van P.Smith's observations. The utility of the quantities p cos 2θ, p sin 2θ for the discussion of internal accuracy and comparison of independent series is stressed.

523.11

2 RADIAL OSCILLATIONS OF THE GENERALIZED ROCHE MODEL. R.Simon.
Astrophys. J., Vol. 127, No. 2, 428-35 (March, 1958).

The radial stationary oscillations of a composite configuration, are investigated in the adiabatic and linear approximations. This model is shown to be capable of oscillations as a whole, without requiring special conditions like those of Sen or Kopal. The proper frequencies are shown to be proportional to the square root of the core density and, moreover, are determined by the chemical composition of the model (ratios of specific heats of the nucleus and of the atmosphere), by the ratio of the radii of the core and of the envelope and by the ratio of their mass. Application is also made to the case of a rigid nucleus, which may be of interest in the theory of planetary atmospheres.

523.16

3 A PHASE SENSITIVE INTERFEROMETER TECHNIQUE FOR THE MEASUREMENT OF THE FOURIER TRANSFORMS OF SPATIAL BRIGHTNESS DISTRIBUTIONS OF SMALL ANGULAR EXTENT. R.C.Jennison.
Monthly Not. Roy. Astron. Soc., Vol. 118, No. 3, 276-84 (1958).

A method is described whereby the amplitude and phase of the complex Fourier transform of a spatial brightness distribution of small angular extent may be uniquely determined from a series of measurements with a triple interferometer system. Absolute measurement of the amplitude function is available, whilst measurements of phase are relative to a datum obtained at short aerial spacings. A practical radio-frequency interferometer incorporating the principle is described and its operation is discussed.

523.16

4 RADIO EMISSION IN THE OUTER CORONA. W.C.Erickson.
Phys. Rev. Letters, Vol. 3, No. 8, 365-7 (Oct. 15, 1959).

Preliminary observations have been made with one section of a new two-mile array working at 26.3 Mc/s. The narrow east-west beam enables the systematic motion of radio sources in the solar corona to be observed. H.J.A.Chivers

523.16

5 RADIO ASTRONOMICAL OBSERVATIONS WITH THE AID OF ARTIFICIAL SATELLITES.
G.G.Getmantsev, V.L.Ginzburg and I.S.Shklovskii.
Uspekhi fiz., Nauk, Vol. 66, No. 2, 157-61 (Oct., 1958). English

translation in: Soviet Physics–Uspekhi (New York), Vol. 66(1), No. 1, 65-7 (Sept.-Oct., 1958). In Russian.

Absorption in the ionosphere impedes the measurements of extra-terrestrial radio waves at wavelengths longer than about 30 m. The use of artificial satellites promises a method of extending the measurements in this region. This paper gives a brief discussion of the requirements that must be met by a receiving apparatus to be carried by a satellite. C.Hazard

523.34 : 531.57

6 SIMILARITIES BETWEEN LUNAR AND HIGH-VELOCITY-IMPACT CRATERS.

W.S.Partridge and H.B.Vanfleet.
Astrophys. J., Vol. 128, No. 2, 416-19 (Sept., 1958).

Craters formed by firing pellets into targets at velocities of from 1 to 3 km/sec exhibit many of the characteristics observed in lunar craters. The mechanism of crater formation is very similar whether the target is (1) a low-strength wax, (2) plaster of Paris, or (3) a metallic substance. The following similarities between lunar and high-velocity craters have been noted: (1) the over-all shape in many cases is very similar; (2) the material in the crater lip and in the raised portions of the surface around the crater is approximately equal to the volume of the crater; (3) systems of rays extending from the centre of the crater have been observed under both conditions; (4) a wrinkled appearance has been observed around the metallic craters which was caused by slippage of crystal planes and resembles very closely the surface surrounding some lunar craters; (5) it is possible to form impact craters with central peaks very similar to those observed in craters on the moon.

523.51

7 ARGON–POTASSIUM AGES AND THE ISOTOPIC COMPOSITION OF ARGON FROM METEORITES.

J.Geiss and D.C.Hess.
Astrophys. J., Vol. 127, No. 1, 224-36 (Jan., 1958).

The potassium and the argon contents of 13 meteorites were measured by the isotopic dilution method. It is proved that the amounts of A^{36} and A^{38} found in these samples are of extra-terrestrial origin, the main source being spallation processes induced by cosmic radiation. In some chondrites an excess of A^{36} compared with A^{38} was found. Possible sources for this A^{36} are discussed. The 7 chondrites measured give ages between 4.4×10^9 and 4.0×10^9 years. The ages of achondrites vary between 4.4×10^9 and 0.7×10^9 years.

523.74

8 THE N–S ASYMMETRY IN SOLAR ACTIVITY. J.Xanthakis.

C.R. Acad. Sci. (Paris), Vol. 249, No. 16, 1458-9 (Oct. 19, 1959). In French.

It is shown that the ratio, $q = (A_n - A_s)/A_t$, where A_t, A_n and A_s are annual values of mean daily areas of spots over the whole visible disk, and in N and S hemispheres respectively, can be represented empirically as a function of the time of growth to sunspot maximum with two periodic terms of periods 2 and 4 solar cycles included. D.R.Barber

523.74

9 MAGNETIC FIELD ASSOCIATED WITH A GREAT SOLAR FLARE. R.Howard, T.Cragg and H.W.Babcock.

Nature (London), Vol. 184, 351 (Aug. 1, 1959).

An exceptionally large S-shaped flare in an active spot group at ~ 18°N, 29°W, was observed at Mt.Wilson on 16 July 1959 between 21.19 and 01.00 U.T. Solar magnetograph patterns showing the distribution of the photospheric magnetic field in the vicinity of the flare gave no indication of any interaction between flare and field. Similar negative results were obtained for 4 smaller flares observed on later dates. D.R.Barber

523.74

10 A SECONDARY [SUN] SPOT ZONE. U.Becker.

Z. Astrophys., Vol. 48, No. 2, 88-94 (1959). In German.

A butterfly diagram of sunspots for the years 1879-1950 is presented giving lines of equal spot areas. In addition to the main equatorial zones, high latitude zones of spot activity are found. The connection between these zones and the polar zones of prominence activity is discussed.

523.75

11 ON THE COMPRESSION OF CORONAL MATTER. K.O.Kiepenheuer.

Z. Astrophys., Vol. 48, No. 4, 290-7 (1959). In German.

Because of very efficient radiative cooling the gas pressure of coronal matter when compressed will not increase. Thus an external pressure will bring coronal matter rapidly to the density and temperature of a prominence. Within a centre of activity the required pressure will be supplied from the colliding or forming magnetic fields, which in addition are needed to protect the cooled volume initially against the bombardment of coronal ions. The results obtained are applied to explain the formation of flare surges.

523.78

12 THE PRECISE TIMING OF THE TOTAL SOLAR ECLIPSE JUNE 30, 1954. H.Kristenson.

Ark. Astron., Vol. 2, Paper 29, 315-43 (1959).

The activities of the Lund eclipse expedition to Sydkoster in 1954, June 30, are reported. The material gathered for the benefit of the geodetic project is discussed and the mid-totality times derived are compared with those obtained by other teams at the same site. The existing discrepancies show the various contact methods to yield results so divergent as to make useless any coordination with the intent to improving the dimensions of the earth. Still, useful results can be obtained provided data proceeding from equivalent observational and reductional procedures are combined. The ephemeris time for the observed right ascension of the moon is determined, and the lunar photometric contour is fitted in with that of the 1945 eclipse.

523.87

13 A TIME SCALE FOR THE MIXING PROCESS IN S-TYPE STARS. E.Anders.

Astrophys. J., Vol. 127, No. 2, 355-62 (March, 1958).

It is shown that neutron production in a late-type star, on the scale proposed by Cameron, leads to a drastic lowering of the Nb/Zr abundance ratio. After removal of the material from the neutron-producing region, the ratio rises again, due to decay of 9×10^5 years Zr^{93} to Nb^{93}. Thus this ratio can be used, in principle, to calculate the mixing time from observational data. The application, limitations, and principal sources of error of the method are discussed.

523.87

14 ON THE EMPIRICAL DETERMINATION OF LINE-ABSORPTION COEFFICIENTS. L.Goldberg.

Astrophys. J., Vol. 127, No. 2, 308-11 (March, 1958).

A method is described for extracting the wavelength dependence of the line-absorption coefficient from observed line profiles, similar in principle to those employed by de Jager and by Athay and Thomas for the derivation of the Doppler widths of the Balmer lines. The method requires the accurate observation of the profiles of pairs of lines of known relative strengths in multiplets but necessitates no prior knowledge of the atmospheric model. The method is applied to the determination of the Doppler widths of the λ 6238 and λ 6248 solar lines of Fe^+ from the recent observations of Suemoto.

525 : 538.56 : 621.396.969.35 : 621.396.946

15 ELECTROMAGNETIC WAVES AND SATELLITES. HIGH-FREQUENCY ECHOES FROM IONIZED TRAILS OF SATELLITES. A.Flambard and M.Reyssat.

Onde elect., Vol. 38, 830-7 (Dec., 1958). In French.

The features of received signals from satellites, due to their motions and the properties of the ionosphere are discussed. The passage of a satellite is compared with the entry of a meteor into the atmosphere. It is concluded that a satellite could be expected to produce an ionized trail of a density detectable by radar. A backscatter ionospheric-sounding radar has been used to search for such ionization and photographic records of radar traces are reproduced showing echoes attributable to satellite trails. W.T.Blackband

525

16 LUNAR-SOLAR PERTURBATIONS OF AN EARTH SATELLITE. L.Blitzer.

Amer. J. Phys., Vol. 27, No. 9, 634-45 (Dec., 1959).

The influence of the sun and moon on the orbit of a near satellite of the earth is investigated, and it is shown that the principal effect is a precession of the orbit plane about the pole of the ecliptic, analogous to the precession of the equinoxes. The precessional rate increases with orbit size and eccentricity and decreases with

orbit inclination to the equator. For orbits close to the earth the lunar-solar precessional motion is only about 10^{-4} that due to the earth's oblateness. Radial perturbations resulting from the attractions of the sun and moon are similarly extremely small, being of the order of one meter. The induced radial oscillations exhibit twice the frequency of the satellite's orbital motion around the earth, analogous to the twice daily motion of the tides. To second-order terms in the orbit eccentricity the expressions derived herein are in exact agreement with the astronomical treatments for the special case of the perturbations of the moon's orbit due to the sun.

525

17 FLASH PERIOD OF 1958 DELTA I.
P.H.Carr, R.M.Stewart, Jr and J.H.Senne.
Amer. J. Phys., Vol. 28, No. 1, 64-6 (Jan., 1960).

Careful observation of the flash period of the artificial satellite, 1958 Delta I (the rocket case of Soviet Sputnik III), was made at Ames, Iowa, from July 21 to November 29. The flash period increased steadily during this time until approximately one-half week before fall-in. This indicated a slowdown in the rate of tumbling of the rocket case. During the last few days of life the flash period decreased, indicating a speedup in tumbling rate. What causes this change? Future satellite observers are urged to observe this phenomenon to see if it is general.

525

18 SIGNALS FROM SATELLITE 1958 δ 2.
B.G.Pressey.
Nature (London), Vol. 184, 261 (July 25, 1959).

The observation by Munro (Abstr. 11764 of 1959) that the pulse modulation of the signals of Sputnik III was absent when the satellite was not illuminated by the sun has been confirmed by observation from Slough and Singapore. The signals were observed to end abruptly within a minute of the predicted time of eclipse.

W.T.Blackband

525

19 A TYPE OF VARIATION OF THE SIGNAL STRENGTH FROM 1958 δ2 (Sputnik 3). L.Liszka.
Nature (London), Vol. 183, 1383-4 (May 16, 1959).

The intensity of observed signal from 1958 δ2 has been observed at Kiruna, Sweden for 200 transits. The results of a statistical survey indicate that there was a tendency towards an enhancement of the signal as the satellite passed beneath an earlier trajectory. The effects of up to 13 earlier transits were observed. Corresponding decreases were observed for passages above past trajectories. These effects are attributed to the persistence of a heavily ionised track left by the satellite. There is some correlation between these phenomena and the total solar flare activity index.

W.T.Blackband

525

20 SOLAR EFFECTS IN THE MOTION OF VANGUARD.
S.P.Wyatt.
Nature (London), Vol. 184, 351-2 (Aug. 1, 1959).

Changes in the period of Satellite 1958 β 2 (Vanguard) show a correlation with (1) the hour angle of the sun as reckoned from the perigee point of the orbit; (2) the 27-day variations in solar activity discovered by Jacchia; (3) the total daily solar insolation at the latitude of perigee. It is suggested that the correlation of drag with time of day at perigee passage is best accounted for by a daily pulsation of the exosphere. Data on Satellite 1958 α seem to show the same behaviour.

C.Hazard

529.7 : 538.56 : 621.373.5 : 621.317.76

21 FREQUENCY VARIATIONS OF QUARTZ OSCILLATORS AND THE EARTH'S ROTATION IN TERMS OF THE N.P.L. CAESIUM STANDARD.
L.Essen, J.V.L.Parry and J.McA.Steele.
Proc. Instn Elect. Engrs, Paper 3002M, publ. Aug., 1959, 4 pp.
To be republished in Vol. 107B, 1960.

The variations in the frequencies of quartz oscillators compared with that of a caesium standard are described and discussed. It is shown that the frequencies of the ring-type oscillators at the N.P.L. and other laboratories do not depart from those given by a linear law of variation by more than ±5 parts in 10^9 over a period of three years. The quartz oscillators calibrated by the caesium standard have been used to study the variations in the period of rotation of the earth. In addition to an annual seasonal variation of approximately ±8 parts in 10^9, there was a fairly steady retardation amounting to 1 part in 10^8 in the period between September, 1955, and January, 1958.

PHYSICS

GENERAL

53

22 GRADUATE EXAMINATIONS IN PHYSICS.
M.W.P.Strandberg and B.V.Gokhale.
Amer. J. Phys., Vol. 27, No. 8, 539-44 (Nov., 1959).

The extensive and intensive character and the number of graduate level examinations for doctoral candidates in physics are discussed in relation to the probable objectives which the examinations are intended to serve. Results of a recent survey of graduate examination procedures in universities in the United States are presented.

53

23 INSTITUTIONAL INFLUENCES IN THE UNDERGRADUATE TRAINING OF Ph.D. PHYSICISTS.
B.R.Siebring and D.H.Schwahn.
Amer. J. Phys., Vol. 27, No. 8, 577-9 (Nov., 1959).

Institutions of the United States are ranked by the ratio of Ph.D.'s in physics granted nationally during 1952 to 1956 to their undergraduate physics majors who received their bachelor's degrees during the period July 1, 1947, to June 30, 1952, as a means of measuring their efficiency in the training of Ph.D. physicists. The data used in calculating these ratios were obtained from the National Academy of Sciences and the United States Office of Education. The top ten institutions were found to be the Hampden-Sydney College, Swarthmore College, University of Colorado, Haverford College, Drew University, Wesleyan University, University of Virginia, Johns Hopkins University, Whitman College, and Cornell University, in that order. As a means of comparing various groups of institutions, composite Ph.D.-bachelor ratios were calculated. From these ratios certain conclusions were drawn. This investigation differed from most other studies of this sort, for in it the Northeastern states were found to be the most productive. The technical schools surpassed the universities and colleges. It was found that the Ph.D. granting institutions had a much higher composite Ph.D.-bachelor ratio than the institutions not offering doctoral work in physics.

53

24 EVALUATION OF HIGH SCHOOL PHYSICS COURSES BY COLLEGE STUDENTS. H.Kruglak.
Amer. J. Phys., Vol. 27, No. 9, 630-4 (Dec., 1959).

Physics students at Western Michigan University rated their high school physics course and instructor. The data were used to identify the outstanding instructors of the area and to reveal their methods. There was a strong relationship between the ratings of the instructors and the ratings of the high school physics course as a preparation for college science courses. There was a significant difference in the general college physics grade distributions of students with and without high school physics.

53

25 BACCALAUREATE ORIGINS OF Ph.D. PHYSICISTS.
B.R.Siebring and D.H.Schwahn.
Amer. J. Phys., Vol. 27, No. 9, 647-8 (Dec., 1959).

Using the data gathered by the National Academy of Sciences about the baccalaureate origin of Ph.D. physicists for the periods 1936-1945, 1946-1950, and 1951-1955, the authors detected certain

trends in the undergraduate training of Ph.D. physicists. It was found that the undergraduate training of physicists who earned doctorates during the years covered by this study was concentrated in a small proportion of this country's institutions of higher education. This concentration in the top institutions was found to be increasing. The North Central states lost the lead in the undergraduate training of Ph.D. physicists to the Northeastern states. This is true both numerically and percentagewise. In terms of percentage contribution, the trend is toward the increasing influence of the technical schools (up 4.75%) rather than the colleges (down 5.2%) and universities (up 0.8%). The Ph.D. granting institutions have led the nongranting Ph.D. institutions over this time span and are increasing their percentage contribution. There is a slow trend from the privately controlled to publicly controlled institutions.

53

26 STRUCTURE, METHODS, AND OBJECTIVES OF THE REQUIRED FRESHMAN CALCULUS-PHYSICS COURSE AT AMHERST COLLEGE. A.B.Arons.
Amer. J. Phys., Vol. 27, No. 9, 658-66 (Dec., 1959).

A description is given of the Amherst freshman calculus–physics course with specific examples of test questions, term paper assignments, and laboratory instructions. A few quotations are given from student papers, and fairly detailed syllabi of the mathematics and physics work are included.

53

27 TRUTH IN PHYSICS. P.F.Schmidt.
Amer. J. Phys., Vol. 28, No. 1, 24-32 (Jan., 1960).

A number of different uses of the concept true are distinguished within physics in order to answer the questions: when is a physical law true? and when is a theory true? It is shown that a law cannot be tested as true or false independently of some theory. The concepts of true in physics are shown to be quite different from those of philosophy. The uses of true in physics make no reference to nature or the external world as is often held, nor do the changes in theories bring one progressively nearer to a correct picture of nature.

53

28 IT IS IMPORTANT TO KNOW WHAT QUESTIONS TO ASK. J.S.Miller.
Amer. J. Phys., Vol. 28, No. 1, 38-42 (Jan., 1960).

The principal concern in the study of physics is: how does Nature behave? The answer is best obtained by finding the answers to an array of simpler fundamental questions. It is important, therefore, to know what questions to ask. This paper bears on several instructional points of view: (1) in the professor's narration there is too much communication of fact and too few of the right kinds of questions asked; (2) textbook problems do not cultivate the habit of asking questions; (3) there should be more general analytic exercises which permit the examination of limiting cases, for in limiting cases lies the heart of the inquiry; (4) demonstration experiments must be accompanied by appropriate questions. Illustrative examples point up the argument.

53

29 CLASSICAL INTERACTION OF AN ELECTRIC CHARGE WITH A MAGNETIC MONOPOLE. I.R.Lapidus and J.L.Pietenpol.
Amer. J. Phys., Vol. 28, No. 1, 17-18 (Jan., 1960).

The motion of a charged particle in the field of a magnetic monopole is calculated classically. The differential scattering cross-section is obtained, and it is seen that in the limit of small interaction strength the cross-section resembles the Rutherford cross-section. A simple relativistic correction is discussed.

53

30 SOME OBSERVATIONS CONCERNING MULTIPOLE FIELDS. E.V.Ivash.
Amer. J. Phys., Vol. 27, No. 7, 522-3 (Oct., 1959).

The author discusses briefly several features of dipole and multipole fields which it is claimed require clarification.

E.G.Knowles

GRAVITATION . RELATIVITY

530.12

31 THE EMPIRICAL FOUNDATION OF THE GENERAL THEORY OF RELATIVITY. E.Finlay-Freundlich.
Scientia (Asso), Vol. 94, No. 8, 181-7 (Aug., 1959).

Among the three possibilities of putting the general theory of relativity to the test two concern the motion of light-photons in the gravitational field of the sun. Of these the predicted deflection of a light beam, passing near to the sun, is as such safely established; however, the observations seem to indicate that the value of the deflection exceeds quite considerably the value predicted by the theory; thus further tests are needed. As to the predicted general red-shift of all solar lines the situation is more complicated. The actually observed red shifts have in character no resemblance whatsoever with the theoretical prediction; this should be simply a constant red-shift, whose value does not depend on the position on the sun's disk from which the light is taken. For the greater part of the sun's disk the observed values are considerably below the expected value, but near the limb the red-shifts rise steeply to values which for many lines exceed the theoretical prediction. One has attempted to split the observed shifts into three components one of which would have to be a constant shift of given value. However, this analysis has not yielded convincing results and the whole problem remains still unsolved.

530.12

32 THE MOTION OF MERCURY ACCORDING TO THE THEORY OF THIRY AND LICHNEROWICZ. K.Just.
Z. Naturforsch., Vol. 14a, No. 8, 751 (Aug., 1959).

An exact solution of the 5-space field equations is derived representing the static field outside a spherically symmetric body. The solution gives a perihelion advance for an uncharged test particle which is greater than 5/4 times that derived from general relativity, the exact value depending on the nature of the electromagnetic field within the attracting body. R.A.Newing

530.12

33 ON MACH'S PRINCIPLE. A.Carrelli.
Nuovo Cimento, Vol.13, No.4, 853-6 (Aug. 16, 1959).

Assuming that the so called principle of Mach ascribes a tensorial character to mass, the peripheral position of the solar system with respect to the great local mass of the Galaxy would be expected to result in the mass of a body varying according to its direction of motion in relation to the galactic plane. An optical experiment using polarized light is proposed whereby the above effect for electrons might be observed. T.R.Carson

530.12

34 ON GRAVITATIONAL RADIATION. A.Peres.
Nuovo Cimento, Vol.13, No.3, 670 (Aug.1, 1959).

A criterion is given which partly removes the ambiguity which arises in connection with the solutions of Einstein's equations representing incoming gravitational waves, the presence of which account for the negative radiated energy previously obtained.

T.R.Carson

530.12

35 NONLINEAR EFFECTS OF GRAVITATIONAL RADIATION. A.Peres and N.Rosen.
Phys. Rev., Vol. 115, No. 4, 1085-86 (Aug. 15, 1959).

It is shown that the cumulative effects of the nonlinear terms in Einstein's equations rule out the possibility of stable small oscillations of a gravitational field about an equilibrium state, if the latter is supposed to be Minkowskian at infinity. The perturbation, if unlimited in time, rather tends to take infinite values at large distances from its source. This can be interpreted as an instability of gravitational radiation fields, and raises doubts concerning the validity of the linearized theory at large distances from the source.

530.12

36 GRAVITATIONAL RED-SHIFT IN NUCLEAR RESONANCE. R.V.Pound and G.A.Rebka, Jr.
Phys. Rev. Letters, Vol. 3, No. 9, 439-41 (Nov. 1, 1959).

An experiment is proposed by which the small dependence, predicted by the theories of relativity, of the frequencies of electromagnetic spectral lines on the gravitational potential at their source,

might be resolved for those γ-rays which are emitted by a solid without individual recoil of the nuclei, and which have been found to have extremely small fractional frequency widths.

E.F.W.Seymour

530.12

37 A SOLUTION OF THE MAXWELL–EINSTEIN EQUATIONS. I.Robinson.

Bull.Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 7, No. 6, 351-2 (1959).

The metric is conformally flat and represents, in the weak field approximation, a set of uniform parallel electrostatic and magnetostatic fields for which the value of $E^2 + H^2$ is prescribed.

R.A.Newing

530.12

38 ON THE LORENTZ-INVARIANT APPROXIMATION METHOD IN GENERAL RELATIVITY. III. THE EINSTEIN–MAXWELL FIELD. R.P.Kerr.

Nuovo Cimento, Vol. 13, No. 4, 673-89 (Aug. 16, 1959).

The methods of Pt I and II (Abstr. 11790-1 of 1959) are extended to the Einstein–Maxwell field. It is shown that it is possible to set up a consistent Lorentz-invariant approximation procedure without it being necessary to expand the particle parameters, such as the mass and the charge. By using an invariant Green's function, an integral expression is calculated for the field. This is a solution of the Einstein–Maxwell field equations, provided that the differential equations of motion, mass, charge, and spin are satisfied for each particle. The result does not depend on the degree of complexity of the first order solution. It is shown that the electromagnetic self forces which appear in the second approximation are significant, whereas it is necessary to go to the fourth approximation before it can be shown that the corresponding gravitational self forces are real and do not disappear in the higher approximations. Also, it is shown that the mass is conserved to the second approximation, but that the charge is not.

530.12

39 ON SOLUTIONS OF THE CLOCK PARADOX. G.D.Scott.

Amer. J. Phys., Vol. 27, No. 8, 580-4 (Nov., 1959).

The nature of the clock paradox is discussed and three solutions are referred to: (a) length contraction, (b) Doppler effects, (c) world lines in chronogeometry. The Special Theory of Relativity gives a complete explanation of the problem and it is pointed out how the use of the General Theory provides merely an additional solution with no physically new aspects. Variation in the clock problem are introduced to make clear the essential asymmetry which exists between the two clocks.

530.12

40 RESOLUTION OF THE CLOCK PARADOX. G.Builder.

Amer. J. Phys., Vol. 27, No. 9, 656-8 (Dec., 1959).

It is shown that the clock paradox of the restricted theory of relativity arose solely out of the elementary mistake of utilizing, in a single calculation, quantities expressed in the measures of two different reference systems.

530.12

41 CERTAIN MATTERS IN RELATION TO THE RESTRICTED THEORY OF RELATIVITY, WITH SPECIAL REFERENCE TO THE CLOCK PARADOX AND THE PARADOX OF THE IDENTICAL TWINS. I. FUNDAMENTALS. W.F.G.Swann.

Amer. J. Phys., Vol. 28, No. 1, 55-64 (Jan., 1960).

The paper first discusses the significance of the meaning of space-time coordinates as attached to "events" in the Lorentzian transformation. Restricted relativity involves two distinct parts: A — the invariance of the forms of the laws under the transformation: B — the hypothesis that similar experiments performed in relatively moving frames S and S' give identical results. The test of A is a matter of pen and paper. B involves the hypothesis that the instruments are such that the actual measurements of space-time coordinates of events shall be related, for the two systems, by the transformation. Only by the postulation of a theory such as the quantum theory, but one relativistically invariant in sense A, can one understand the relationship between the instruments, whether the said instruments be constructed by independent observers in S and S' from the material around them, or whether the observer in S' acquires his instruments from S by setting them in motion. The second method of acquiring the instruments will not, in all cases, yield measurements related by the transformation. Thus, if we start with a system of isolated clocks which have been synchronized in S according to Einstein's principle, and if we transfer them to S', their "rates" (in a suitably defined manner) may be expected to alter in accordance with the transformation. However, it will remain for the observer in S' to synchronize the clocks in that new frame, having adjusted the time origin of one of them.

530.12

42 TIME RETARDATION IN STATIC AND STATIONARY SPHERICAL AND ELLIPTIC SPACES. J.Kronsbein and E.A.Farber.

Phys. Rev., Vol. 115, No. 3, 763-4 (Aug. 1, 1959).

The well-known clock paradox is shown to be resolvable and consistent within the framework of the Lorentz Group, using fewer assumptions about the observers than previously. In particular it is not necessary in the spaces indicated to consider the effects of initial acceleration and final deceleration of the observers' clocks since the existence of certain parallel periodic orbits makes it possible to confine observations to times of arbitrary length during which the relative velocity remains constant in a sense previously described. Complete agreement between the observers is attained, thus showing that despite the notion of "relative motion" it is possible to decide which of the two observers is subject to time retardation.

QUANTUM THEORY

(Applications of quantum theory to elementary particles and nuclei are included under Nuclear Field Theory)

530.14

43 ON ACCIDENTAL DEGENERACY IN CLASSICAL AND QUANTUM MECHANICS. H.V.McIntosh.

Amer. J. Phys., Vol. 27, No. 9, 620-5 (Dec., 1959).

The theory of accidental degeneracy is surveyed, particular attention being paid to the connection between the accidental degeneracy of the two-dimensional isotropic harmonic oscillator and the theory of angular momentum.

530.14

44 A REMARK ON THE PARADOX OF EINSTEIN, PODOLSKY AND ROSEN. R.Kawabe.

Nuovo Cimento, Vol. 13, No. 2, 448-50 (July 16, 1959).

The paradox posed by the hypothetical experiment of Einstein, Podolsky and Rosen is discussed in the light of the recent theory of Green of the process of interplay between observables and detectors. It is shown that there is no inconsistency in the quantum mechanical conclusion regarding the correlation of spin components suggested by the experiment. T.R.Carson

530.14

45 A NEW MATHEMATICAL FORMULATION OF QUANTUM MECHANICS IN THE FRAMEWORK OF WAVE-PACKET THEORY. M.Namiki and R.Iino.

Suppl. Progr. theor. Phys., No. 5, 65-122 (1958).

The transformation theory of quantum mechanics is constructed on the mathematical basis of the theory of the linear functionals and the physical notion of the wave-packet formalism of the theory. The wave-packet function, which is described by an indefinitely differentiable and rapidly decreasing function, specifies the regions of the values of some physical quantities corresponding to the physical situation. The wave-functions or the transformation functions are considered to be the linear continuous functionals which have the wave-packet functions as their functional arguments and transform the wave-packet functions to the other ones. The dynamics of quantum mechanics is constructed on the former (the wave-functions as functionals) but not on the latter (the wave-packet functions). The theory never contains improper functions and integrals. The present formalism is physically interpreted as a sort of the wave-packet theory of quantum mechanics. The formal theory of scattering is formulated in the framework of this theory without resort to any ϵ-manipulation and the adiabatic assumption, in order to investigate the conditions for potentials and the behaviours of the evolution operator at infinite past and future. Finally, the definition is given for the higher-order functional derivatives. They may suggest a method of treating the overlapping singularities.

STATISTICAL MECHANICS
TRANSFER PROCESSES

530.16 : 537.533

46 PROPOSED DIRECT TEST OF THE UNCERTAINTY PRINCIPLE. P.R.Ryason.

Phys. Rev., Vol. 115, No. 4, 784-5 (Aug. 15, 1959).

The behaviour of single particles is a central issue in the interpretation of the quantum theory. Yet, the observation of single particles under well-controlled conditions has been difficult. Field-ion and field-emission microscopy permit the ready observation of single particles. It is proposed to test the relation $\Delta E \Delta t \approx \hbar$ by the pulsed-field desorption of single particles from the tip of a field-emission microscope. The conditions for such an experiment are briefly discussed.

530.1ʊ

47 COLLECTIVE EXCITATIONS OF FERMI GASES. J.Goldstone and K.Gottfried.

Nuovo Cimento, Vol. 13, No. 4, 849-52 (Aug. 1ʊ, 1959).

It is shown by an elementary treatment based on the Hartree–Fock equation that a number of alternative approaches to the problem of collective motions in Fermi gases are in fact equivalent. The authors feel that their contribution is only pedagogic in nature.

P.T.Landsberg

530.16

48 MANY-PARTICLE PROBLEMS. L.van Hove.

Ned.Tijdschr. Natuurkde, Vol.25, No.8 227-39 (Aug., 1959). In Dutch.

A review of the following topics: Feynman diagrams and cluster expansions in perturbation theory, exact summation of perturbation series and approximate Hamiltonians, applications to Bose and Fermi gases, the Fermi gas with short range interactions, excited states, collective coordinates.

E.P.Wohlfarth

530.16

49 ENERGY LEVELS OF A BOSE–EINSTEIN SYSTEM OF PARTICLES WITH ATTRACTIVE INTERACTIONS. K.Huang.

Phys. Rev., Vol. 115, No. 4, 765-77 (Aug. 15, 1959).

An N-body Bose–Einstein system of particles with long-range attraction and hard-sphere repulsion between particles is considered. It is shown that if the constants of the interaction have values within a certain range it is possible to calculate the ground-state energy of the system as a function of Ω/N, where Ω is the volume of the box containing the system, in the limit $N \to \infty$, $\Omega \to \infty$, with $N/\Omega = \rho$ fixed. The results show that the system can possess an N-body bound state, which has an equilibrium density and negative energy, and that the interactions can be saturating. Excited states are also considered. It is shown that low-lying excitations consist purely of phonons, whose velocity agrees with that computed from the macroscopic compressibility, furnished by the ground-state energy. The formula for the general excited energy levels suggests that thermodynamically the system may have a "gas" phase and two "liquid" phases, the transition between the two "liquid" phases being the analogue of the Bose–Einstein condensation of the ideal gas. Thermodynamic considerations are, however, not contained in this paper.

530.16

50 ADIABATIC INVARIANTS OF PERIODIC CLASSICAL SYSTEMS. C.S.Gardner.

Phys. Rev., Vol. 115, No. 4, 791-4 (Aug. 15, 1959).

Recently there has been renewed interest in adiabatic invariants of simply-periodic classical systems subject to perturbation by slow variation of parameters. In several interesting cases it has been shown that if the system varies slowly from one steady state to a different steady state, the appropriate adiabatic invariant is constant to an arbitrarily high order in a slowness parameter. It is shown here how these and similar results may be derived by systematic use of a technique of perturbation theory of classical Hamiltonian systems. The method is essentially iteration of the transformation to action and angle variables.

530.16

51 COLLISION TERM IN THE BOLTZMANN TRANSPORT EQUATION. E.A.Desloge and S.W.Matthysse.

Amer. J. Phys., Vol. 28, No. 1, 1-11 (Jan., 1960).

The scattering probability W(v,v'), associated with particles of mass m interacting by means of hard elastic collisions with moving scatterers of mass M, is obtained in terms of the corresponding scattering probability associated with scattering from rigid elastic scatterers. The collision term in the Boltzmann transport equation can then be written in a form which is convenient for handling both equilibrium and transport phenomena. The conditions of equilibrium are discussed. The approximate collision term for a distribution function of the form $f(v) = f_0(v) + v_x g(v)$ is derived, and the results applied to the problem of the conductivity to microwaves of a slightly ionized gas.

530.16

52 VARIATIONAL PRINCIPLE FOR TRANSPORT PHENOMENA. G.E.Tauber.

J. Franklin Inst., Vol. 268, No. 3, 175-221 (Sept., 1959).

The role of the variational principle in transport theory and its application to the calculation of the transport coefficients are described. A generalized variational principle including the effect of an external magnetic field and lattice vibrations is discussed. The variational principle for inter-band scattering is derived, and is generalized by the introduction of an external magnetic field and lattice vibrations, leading to the most general variational principle including inter-band scattering, in addition to an external magnetic field and lattice vibrations, or any combination of these. The transport coefficients are expressed in terms of energy integrals, which for the various cases take the form of ratios of infinite determinants; the number and form of their matrix elements depending on the interactions. A formal solution is given by the Ritz method for the different cases of interest.

530.19 : 539.18

53 THE THEORY OF RADIATION DIFFUSION. NON-STATIONARY AND STATIONARY FLUORESCENCE. II. R.Seiwert.

Optik, Vol. 16, No. 6, 358-70 (June, 1959). In German.

For Pt I, see Abstr. 4321 (1959). It is shown how to obtain the decay and excitation of resonance fluorescence when the density of the first, second, third ... order excited atoms is known. For this purpose, the intensities of the separate orders of the fluorescence radiation must be calculated, taking the nature of the experimental set-up into consideration. A method is also discussed for the approximate calculation of the cross-sections of second kind collisions on the basis of examinations of fluorescence where diffusion occurs. Modifications in the derived equations are discussed in order to be able to apply them to the fluorescence of solutions of organic substances.

GENERAL MECHANICS

531.25

54 BENDING OF A THIN, SEMI-INFINITE PLATE RESTING ON AN ELASTIC LAYER OF FINITE THICKNESS. R.V.Serebryanyĭ.

Dokl. Akad. Nauk SSSR, Vol. 125, No. 4, 752-5 (April 1, 1959). In Russian.

The load is applied near the edge of the plate, so that its effects at infinity can be neglected. Formal solution is constructed subject to the usual boundary conditions near the free edge; its method follows the operational technique developed by Muskheleshvili, leading to an integral equation with the kernel of the Wiener–Hopf type.

J.K.Skwirzynski

531.39

55 CHANGE OF A VISCOELASTIC SPHERE TO A TORUS BY RANDOM IMPACTS. W.F.Busse and F.C.Starr.

Amer. J. Phys., Vol. 28, No. 1, 19-23 (Jan., 1960).

When a small (< 2.5 g) ball of silicone putty was put into a vibrating cylinder, it first bounced around like a rubber ball. After some time the motion produced by the random impacts caused the sphere to change to a torus, and ultimately it broke up into smaller "dog bone" shaped pieces. If the size of the initial sphere was increased to 4-5 g or more, the spherical shape remained stable for many hours. When the initial shape was changed from a sphere to a cube to a prism, the minimum critical size that would form a stable sphere increased from about 3 to 6 to 20 g, respectively. The formation of the torus is due to the combined effect of the spectrum of relaxation times of the material, the short time of impacts with

the wall, and the tendency of a body in free flight to rotate around the axis having the highest moment of inertia.

531.53

56 AMPLITUDE-DEPENDENCE OF FREQUENCY IN A LINEAR APPROXIMATION TO THE SIMPLE PENDULUM EQUATION. H.H.Denman.
Amer. J. Phys., Vol. 27, No. 7, 524-5 (Oct., 1959).

It is suggested that expansion of sin θ (i.e. the restoring force term), in this equation, in a series of Chebyshev polynomials, gives a better first-order amplitude-dependence of frequency than the usual Taylor series expansion. J.K.Skwirzynski

531.55

57 VELOCITY OF A BODY FALLING THROUGH THE ATMOSPHERE AND THE PROPAGATION OF ITS SHOCK WAVE TO EARTH. G.V.Groves.
J. atmos. terrest. Phys., Vol. 10, No. 2, 73-83 (Feb., 1957).

A solution is obtained for the velocity of a body falling to earth from a point outside the appreciable atmosphere. The motion is characterized by the single parameter $p^* = mg \sin\theta/SC_D$, where m is the mass, g the gravitational acceleration, θ the flight path angle to the horizontal, and S the frontal cross-sectional area of the body. Graphs are presented showing velocity and deceleration against height for falls from 100, 200, and 300 km and for various values of p^*. It is shown that the deceleration is greatest at heights where the atmospheric pressure is approximately p^*, and that the rate of loss of energy is greatest at heights where the atmospheric pressure is approximately p^*, and that the rate of loss of energy is greatest at heights where the pressure of approximately $\frac{2}{3}p^*$. The effect is considered of refraction arising from the temperature structure of the atmosphere on the shock wave generated by a vertically-falling body. It is shown that only a part of the shock wave originating in the lower atmosphere will reach earth in the case of falls from above 120 km; but for falls from below this height, an additional part of the shock wave originating in the region of the temperature maximum at 50 km may also reach earth. Curves are plotted showing the horizontal range from the impact point at which shock waves originating in the lower atmosphere reach earth for bodies falling vertically from 100, 200 and 300 km with various values of p^*.

531.56

58 EFFECT OF SPIN AND SPEED ON THE LATERAL DEFLECTION (CURVE) OF A BASEBALL; AND THE MAGNUS EFFECT FOR SMOOTH SPHERES. L.J.Briggs.
Amer. J. Phys., Vol. 27, No. 8, 589-96 (Nov., 1959).

The effect of spin and speed on the lateral deflection (curve) of a baseball was measured by dropping the ball while spinning about a vertical axis through the horizontal wind stream of a 6 ft tunnel. For speeds up to 150 ft/sec and spins up to 1800 rev/min, the lateral deflection was found to be proportional to the spin and to the square of the wind speed. When applied to a pitched ball in play, the maximum expected curvature ranges from 10 to 17 in., depending on the spin. The deflections of rough baseballs accord in direction with that predicted by the Magnus effect. But with smooth balls at low speeds the deflection is in the opposite direction. This is studied with an apparatus specially designed to measure the pressure at any point in the equatorial plane of the rotating ball.

531.57

59 LITHIUM GUN. H.J.Bomelburg.
J. appl. Phys., Vol. 30, No. 9, 1467-8 (Sept., 1959).

Describes a combination of the principles of the electric discharge gun and of the light gas (lithium) gun to increase projectile velocities, under certain conditions, to about 25 000 ft/sec. With further experimentation velocities in the neighbourhood of 50 000 ft/sec seem, to the author, to be possible. W.Good

531.57 : 523.34

SIMILARITIES BETWEEN LUNAR AND HIGH-VELOCITY-IMPACT CRATERS. See Abstr. 6

MECHANICAL MEASUREMENTS

531.71 : 535.41

60 MICRO-INTERFERENCE AS AN AID TO TESTING THE SHAPE OF ASPHERICAL SURFACES. R.Landwehr.
Ann. Phys. (Leipzig), Folge 7, Vol. 4, No. 1-5, 154-66 (1959). In German.

The testing of the strongly curved aspherical surfaces of rotation now so widely used can be carried out with a micro-interference method. Measurements made over small regions permit an analysis of the whole. The theory of the method is developed in detail and the equations of the interference curves are derived. Interference curves are given for a paraboloid viewed in various zones and special cases are numerically evaluated. It is shown that the interferometric results are in agreement with spherometer measurements. S.Tolansky

531.75

61 SIMPLE RECORDING THERMOBALANCE FOR VACUUM AND PRESSURE STUDIES.
J.G.Rabatin and C.S.Card.
Analyt. Chem., Vol. 31, No. 10, 1689-92 (Sept., 1959).

The balance is for operation in vacuum, at 1 atm and at up to 600 lb/in^2 pressure, with such gases as carbon dioxide, nitrogen, hydrogen sulfide, carbon monoxide, oxygen and ammonia. Its principle features are a torsion mechanism and a photocell-light transducer system which permit easy operation at high pressure in a medium-sized pressure chamber. The present thermobalance was compared with the Chevenard balance. Maximum sensitivity is about ±0.2 mg for weight changes of 100 to 200 mg.

531.78

62 A METHOD OF MEASUREMENT WITH THE VIBRATING-WIRE EXTENSOMETER. F.Zanchi.
R.C. Ist. Super Sanita, Vol. 22, Pt 4, 311-32 (1959). In Italian.

An exploration of the possibility of a resonance method for measurements on stretched strings. After reviewing existing methods, a new scheme is proposed in which two identical, stretched wires form adjacent arms of a Wheatstone bridge. An electromagnet is placed near one wire, and is energized by an alternating current of constant voltage and varying frequency f. The out-of-balance current in the bridge galvanometer is plotted against f and its maximum value indicates the resonant frequency of the wire. A number of determinations were made, on different wires at different tensions and were found to agree within 2% with the values obtained by other methods. It is concluded that the apparatus described is a simple, rapid, and reasonably accurate tool for investigation of extension problems. N.Corcoran

MECHANICS OF FLUIDS

(See also Magnetohydrodynamics)

532.1

63 ON THE CALCULATION OF THE MEAN EFFECTIVE PRESSURE HEAD FOR CAPILLARY VISCOMETERS.
R.H.Ottewill and J.Th.G.Overbeek.
Proc. K. Ned. Akad. Wetensch. B, Vol. 62, No. 4, 236-47 (1959).

When capillary viscometers are used for measurements at different rates of shear, accurate evaluation of the mean effective pressure head is required for calculation of the rate of shear. At high pressure heads an arithmetic mean value of the heads at the beginning and end of the experiment may be used, but for low pressure heads this procedure is incorrect. The situation is examined theoretically and formulae are obtained which enable the mean effective pressure head to be calculated from viscometer dimensions and measurements of the pressure head at the beginning and end of flow from the index bulb. The main case examined is for flow from a spherical bulb into a cylinder.

532.1 : 537.3

64 MOLTEN SALTS. THE DENSITY AND ELECTRICAL CONDUCTIVITY OF THE SYSTEMS: $AgNO_3$–$Ba(NO_3)_2$, –$Ca(NO_3)_2$, AND –$Mg(NO_3)_2$. J.W.Murphy and F.E.W.Wetmore.
Canad. J. Chem., Vol. 37, No. 9, 1397-401 (Sept., 1959).

The density and electrical conductivity of the systems $AgNO_3$–$Ba(NO_3)_2$, –$Ca(NO_3)_2$, and –$Mg(NO_3)_2$ have been determined from 210 to 320° and from 0-20 equiv. %. The addition of magnesium nitrate causes the greatest shrinkage of the equivalent volume and reduction of the conductivity, barium nitrate the least. The low conductivity of the binary melts is explained in terms of a mechanism involving restricted jumps and variation of the energy barrier with temperature and kind of ion added.

532.1

65 ON THE DILATATIONAL VISCOSITY OF SIMPLE DENSE FLUIDS. S.A.Rice.

Phys. of Fluids, Vol. 2, No. 5, 579-80 (Sept.-Oct., 1959).

A calculation of the coefficient of volume viscosity of a fluid in terms of molecular-pair correlation and potential functions gives a value 1.8×10^{-3} poise for liquid argon at 89°K, and predicts a vanishingly small volume viscosity as the density tends to zero. The predicted ratio of volume viscosity to the intermolecular-force contribution to the shear viscosity is 5/3. J.G. Oldroyd

532.5

66 THE STEADY FLOW OF VISCOUS FLUID AT LOW REYNOLDS NUMBERS PASSING OBLIQUELY THROUGH A PLANE GRID MADE OF EQUAL PARALLEL CIRCULAR CYLINDERS [REGULARLY SPACED]. K.Tamada and H.Fujikawa.

J. Phys. Soc. Japan, Vol. 14, No. 2, 202-16 (Feb., 1959).

Discussed on the basis of Oseen's equations of motion. Explicit expressions for the force experienced by a cylinder in the grid, for the direction of the flow at infinity downstream, and for the pressure drop caused by the grid are obtained correct to the first order in the Reynolds number and in the diameter–distance ratio of the grid. Among the results are the following. The flow is deflected by the grid more or less in the direction of the normal to the grid surface and is always slowed down at infinity downstream. At very small Reynolds numbers, the flow becomes almost perpendicular to the grid even as far upstream and, hence, the component of force tangential to the grid surface vanishes, while the normal component of force to the grid surface becomes equal, in its magnitude, to the drag when the grid is set at right angles to the uniform stream whose velocity is equal to the normal component of the original velocity.

532.5

67 ON TAYLOR INSTABILITY OF PLANE SURFACES. S.G.Bankoff.

Phys. of Fluids, Vol. 2, No. 5, 576 (Sept.-Oct., 1959).

The dispersion relation and stability criterion are given for a horizontal boundary between two fluid slabs sliding past each other. Various special cases, illustrating the effects of gravity, viscosity, surface tension and finite slab thickness, are investigated. O.Penrose

532.5

68 PHENOMENOLOGICAL EQUATIONS OF STATISTICAL DYNAMICS OF AN INCOMPRESSIBLE TURBULENT LIQUID. B.I.Davydov.

Zh. eksper. teor. Fiz., Vol. 35, No. 2(8) 527-9 (Aug. 1958).
In Russian. English translation: Soviet Physics–JETP (New York), Vol. 35(8), No. 2, 364-5 (Feb., 1959).

By averaging the Navier–Stokes equations, a set of simultaneous nonlinear partial differential equations is obtained for determining the mean products of velocities. Approximate solutions of these equations are obtained which are valid in the boundary layer and are in accordance with experiment. R.Eisenschitz

532.6

69 TWO CONTRASTING THEORIES OF CAPILLARY ACTION. E.K.Chapin.

Amer. J. Phys., Vol. 27, No. 9, 617-19 (Dec., 1959).

Two theories regarding the mechanism of the rise of a liquid in a capillary tube appear in current textbooks of physics and physical chemistry. In one theory the rise is attributed to hydrostatic pressure; in the other, the liquid is drawn up the tube by a climbing meniscus. Evidence is presented in favour of the latter theory.

532.6

70 DIFFERENCE BETWEEN DYNAMIC AND STATIC SURFACE TENSIONS. S. Kondo.

J. Phys. Soc. Japan, Vol. 13, No. 12, 1551 (Dec., 1958).

The author considers a plane non-equilibrium interface between phases α and β, and considers the system as composed of many thin, homogeneous layers $-u, \ldots, 0, 1, \ldots, w$, with thickness d, each parallel to the interface. Let p_T^t denote the tangential pressure of the t^{th} layer; p^α and p^β the pressures of bulk phases α and β. The definition of surface tension which is applicable to non-equilibrium interfaces as well gives

$$\gamma = d\sum_{t=-u}^{w} (p^{\alpha\beta} - p_T^t), \ldots\ldots (1)$$

$$p^\alpha = p^\alpha[1 - A(t)] + p^\beta A(t);\ A(t) = \begin{cases} 0, t \leq 0 \\ 1, t \geq 0 \end{cases} \ldots (2)$$

where a Gibbs dividing surface is placed between the layers 0 and 1. For a fresh surface of pure liquid, density greater than that of a corresponding equilibrium interface (1) shows the dynamic surface tension of a pure liquid to be less than the static. Similarly the surface tension of a non equilibrium interface, where the density transition from liquid to vapour is less sharp than in the equilibrium interface, is shown to be larger than the static. For a dilute solution in the case of positive adsorption dynamic surface tension is larger than static while the reverse is the case for negative adsorption. T. C. Toye

532.6

71 THE ELIMINATION OF ERRORS DUE TO EVAPORATION OF THE SOLUTE IN THE DETERMINATION OF SURFACE TENSIONS. J.R.Hommelen.

J. Colloid Sci., Vol. 14, No. 4, 385-400 (Aug., 1959).

The surface tension of the higher alcohols in water was measured with the de Noüy tensiometer, using first an open and then a closed dish. In the former case higher values were obtained through evaporation losses. To avoid similar errors with the hanging drop method, where the heavy vapours do not remain near the drop, it was found necessary to form the drop very close to the surface of the solution which is saturating the surrounding air. For dilute solutions of caprylic acid in HCl, results obtained in a closed dish with the ring method were practically identical to results with the hanging drop method, when the drop was 0.2 cm from the surface. R.Schnurmann

532.6

72 THE INFLUENCE OF THE MECHANICAL WORKING OF A LIQUID UPON THE ROTATIONAL KINETIC EFFECT OF ITS SURFACE TENSION. M. Borneas and I. Băbuţia.

C.R. Acad. Sci. (Paris), Vol. 248, No. 23, 3281-3 (June 8, 1959).
In French.

It was found that continuous rotation of a liquid moves the inversion point of the rotational kinetic effect towards higher temperatures. It takes a considerable time before the inversion point for the unworked condition can again be obtained. At a temperature at which the rotational kinetic effect is negative, shaking of the liquid makes the effect positive, whereas shaking does not make it negative when it was positive beforehand. Experiments were also done where shaking was done for a second time one and a half hours after the first shaking. R. Schnurmann

532.6

73 DOES THE ROTATING OF A LIQUID HAVE A SPECIAL INFLUENCE ON THE SURFACE FILM?

M.Borneas and I.Babuţia.

C.R. Acad. Sci. (Paris), Vol. 249, No. 12, 1036-8 (Sept. 21, 1959).
In French.

The surface tension of glycol, water, benzene, and butyl alcohol, measured at speeds of rotation between 33 and 122 rev/min by observing an angle at rupture (using a ring technique) was found to be different from (usually greater than) the static value, and to have a non-linear variation with temperature. The effect cannot be reproduced by giving the liquid a translational velocity instead. J.G.Oldroyd

LIQUID STATE

(Liquid helium is included under Low-Temperature Physics)

532.7

74 STRUCTURE OF NONUNIFORM LIQUIDS. G.H.A.Cole.
Amer. J. Phys., Vol. 27, No. 8, 545-54 (Nov., 1959).

In an earlier paper (Abstr. 3197 of 1959) the modern arguments which lead to an understanding of a simple classical liquid under uniform conditions were considered. The more general case of nonuniform liquids is treated in the present paper and the methods currently used to determine the physical structure under these conditions are explained.

532.7

75 SOLUBILITY OF OXYGEN, NITROGEN AND ARGON IN LIQUID HYDROGEN. L.Weil and P.Petit.
Bull. Inst. Internat. Froid, Annexe 1958-1, 271-4. In French.

Measurements are reported of the solubility of nitrogen, oxygen and argon in liquid hydrogen between 20° and 33° K and up to pressures of 35 atm. The solubility of oxygen and argon is quite negligible in the temperature interval under consideration. The results obtained with nitrogen are in accordance with those of Dokoupil, van Soest and Swenker published earlier.

532.7

76 TRANSLATIONAL FRICTION OF MICROSCOPIC SPHERES IN CONCENTRATED POLYMER SOLUTIONS. S.D.Morton and J.D.Ferry.
J. phys. Chem., Vol. 63, No. 8, 1335-6 (Aug., 1959).

Sedimentation coefficients were measured, in the Svedberg oil turbine ultracentrifuge, for polystyrene spheres of diameters 880, 1380 and 1880 A at about 0.05% concentration in solutions of unfractionated polyacrylic acid. Calculations based on Stokes's formula show that the effective viscosity in these experiments is less than the macroscopic viscosity of the solution by a factor of 80 to 1400, and is sometimes very nearly the viscosity of the solvent. J.G.Oldroyd

532.7

77 ON THE DETERMINATION OF THE SEDIMENTATION EQUILIBRIUM SECOND VIRIAL COEFFICIENT IN POLYMERIC SOLUTIONS. H.Fujita.
J. phys. Chem., Vol. 63, No. 8, 1326-8 (Aug., 1959).

For non-ideal solutions of polydisperse neutral molecules expressions are derived for the intercept and limiting slope of a plot of $(M_{app})^{-1}$ against C_0 (the initial concn.) as C_0 tends to zero, M_{app} being the "apparent" weight-average molecular weight of the solute. It is shown that this intercept allows evaluation of the weight-average molecular weight and that the limiting slope can be correlated with the second virial coefficient obtained from light scattering measurement. W.Good

532.7

78 CONVECTIVE DIFFUSION IN LIQUID SOLUTIONS IN THE REGION OF TURBULENCE. I.R.Krichevskii and Yu.V.Tsekhanskaya.
Dokl. Akad. Nauk SSSR, Vol. 122, No. 2, 258-9 (1958). In Russian.

An expression determining the rate of propagation of a solute in turbulent flow of the solution was put forward by Levich. This formula is put to an experimental test. Measurements are made of the rate of flow of a solute (terephtalic acid) towards a rotating disk. As solvents dilute acqueous solutions of ammonia, hexamethylamine and and triethylamine were used. Agreement of the formula with experiment is fair. R.Eisenschitz

532.7 : 539.12

79 DIFFUSIVE MOTIONS IN LIQUIDS AND NEUTRON SCATTERING. B.N.Brockhouse.
Phys. Rev. Letters, Vol. 2, No. 7, 287-9 (April 1, 1959).

Describes neutron scattering experiments in water, ice and heavy water. Temperatures were varied between 6 and 60° C. Graphs are given of intensity of scattered radiation against wavelength, and of the half-width of the energy distribution of the elastically scattered neutrons against temperature. It is concluded that the diffusive movement of the molecules can neither be adequately represented by a set of jumps nor by a fully continuous displacement. R.Eisenschitz

532.7 : 539.12

80 ATOMIC MOTIONS IN WATER BY SCATTERING OF COLD NEUTRONS. D.J.Hughes, H.Palevsky, W.Kley and E.Tunkelo.
Phys. Rev. Letters, Vol. 3, No. 2, 91-3 (July 15, 1959).

The scattering of Be-filtered "cold" neutrons (about 0.005 eV) by water was studied, the neutrons scattered at 90° being passed through a slow chopper and their energies established by time-of-flight measurements. The spectrum of scattered neutrons was not continuous, as might have been expected for a classical liquid, but showed a number of definite energy levels not all of which are understood. No broadening of the incident spectrum was observed. The results disagree with those of Brockhouse (see preceding abstract). J.Thewlis

532.7 : 535.3

81 MEASUREMENT OF THE COMPLEX INDEX OF REFRACTION OF LIQUIDS BELOW 5-MM WAVELENGTH. C.Pine, W.G.Zoellner and J.H.Rohrbaugh.
J. Opt. Soc. Amer., Vol. 49, No. 12, 1202-8 (Dec., 1959).

A variable-length reflection cell is employed in the free-space determination of the complex index of refraction of liquids at mm wavelengths. Explicit expressions are obtained for both the ordinary index of refraction η and the extinction coefficient κ. The results of measurements on toluene, dioxane, and cyclohexane are reported for wavelengths of 4.2 mm, 3.2 mm, and 1.8 mm.

532.7 : 535.3

82 ABSORPTION OF RADIATION IN LIQUID WATER. E.I.Bocharov and A.S.Krutikov.
Izv. Akad. Nauk SSSR, Ser. geofiz., 1958, No. 7, 923-6. In Russian. English summary: PB 141042T-3, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

The authors remeasured the absorption bands in the spectrum of liquid water in the 2000 - 7000 cm^{-1} region using LiF and NaCl prisms. The positions and the absorption coefficients of the observed bands are compared with the results of other workers. A variable-length absorption cell capable of giving very thin samples (0.4 microns), is also described. D.L.Greenaway

532.7 : 535.3

83 INFRARED DISPERSION OF ABSORBING LIQUIDS BY CRITICAL ANGLE REFRACTOMETRY. J.H.Jaffe, H.Goldring and U.Oppenheim.
J. Opt. Soc. Amer., Vol. 49, No. 12, 1199-202 (Dec., 1959).

A critical angle method is described for determining refractive indexes of moderately absorbing liquids ($k < 0.03$). It is pointed out that when the sample is absorbing the value of the critical angle depends upon the extinction coefficient as well as the refractive index. Dispersion data are given for weak infrared bands of $CHCl_3$ and CS_2.

532.7 : 535.32

84 INFRARED DISPERSION OF SOME ORGANIC LIQUIDS. R.E.Kagarise.
J. Opt. Soc. Amer., Vol. 50, No. 1, 36-9 (Jan., 1960).

The dispersion of carbon tetrachloride, carbon disulphide, chloroform, cyclohexane, tetrachloroethylene, methylene iodide, acetone, and perfluoro 1,3,5-trimethylcyclohexane was measured in the 2-15μ region using an interferometric method. The problem of assigning the proper orders of interference to the observed fringe system has been solved by studying the compounds of interest dissolved in carbon disulphide and carbon tetrachloride. Since the orders of interference can be reliably determined for these two solvents one can follow the shift in order as the concentration of the solute is increased in a stepwise fashion from 0 to 100%.

532.7 : 535.34

85 INTENSITY STUDIES IN RAMAN EFFECT. III. RELATIVE INTENSITIES OF RAMAN LINES IN LIQUIDS. K.Venkateswarlu and G.Thyagarajan.
Z. Phys., Vol. 156, No. 4, 561-5 (1959).

For Pt II, see Abstr. 10795 of 1959. The intensities of Raman lines due to CH, CH_2 and CH_3 groups in some n-paraffin hydrocarbons have been obtained relative to the peak intensity of the 458 cm^{-1} line of CCl_4 and compared. The integrated intensity as well as the standard intensity of the C=O frequency in some unconjugated and conjugated ketones, aldehydes and esters have been obtained and the influence of conjugation has been discussed. The intensity of the C=C frequency has also been obtained in the conjugated compounds and compared with the results obtained for the unconjugated compounds.

532.7 : 535.34

86 INTENSITY STUDIES IN RAMAN EFFECT. IV. DEPOLARISATION FACTORS OF RAMAN LINES IN LIQUIDS. K.Venkateswarlu and G.Thyagarajan.
Z. Phys., Vol. 156, No. 4, 566-8 (1959).

The depolarization factors of CCl_4, $CHCl_3$ and C_6H_6 have been obtained for two different modes of excitation and using unpolarized and linearly polarized incident light. The results are discussed in relation to the theoretical predictions.

532.7 : 535.34

87 INTENSITY STUDIES IN RAMAN EFFECT. V. OVERTONE LINES IN SOME LIQUIDS.
K.Venkateswarlu and G.Thyagarajan.
Z. Phys., Vol. 156, No. 4, 569-72 (1959).

Overtone lines have been recorded of CCl_4, $CHCl_3$, $C_2H_2Cl_2$, $C_2H_4Cl_2$, C_6H_5Cl, CH_3OH and CS_2 and their integrated intensities have been estimated. The ratio of the intensities of the fundamental and the overtone has also been determined, wherever it is possible. While recording the overtones, some new lines have been obtained for $C_2H_2Cl_2$, $C_2H_4Cl_2$ and C_6H_5Cl.

532.7 : 535.37

88 THE NATURE OF NON-ACTIVE ABSORPTION IN ANTI-STOKES EXCITATION OF FLUORESCENCE.
V.I.Shirokov.
Optika i Spektrosk., Vol. 5, No. 4, 478-9 (1958). In Russian.

Levshin (1951) and Stepanov (1956) suggested that non-active vibrational absorption, which competes with absorption by electrons, is one of the possible reasons for the decrease of fluorescence yield on anti-Stokes excitation. The present paper reports a qualitative test of the above suggestion in the case of rhodamine B and uranin solutions. The results obtained show that the Levshin–Stepanov hypothesis must be abandoned together with the suggestion due to Jablonski (1954) that the fall in the fluorescence yield is caused by superposition of the fundamental absorption band and the absorption of nonluminescent dimers. A.Tybulewicz

532.7 : 538.27

89 MAGNETIC SPIN PUMPING IN FLUIDS CONTAINED IN POROUS MEDIA.
H.C.Torrey, J.Korringa, D.O.Seevers and J.Uebersfeld.
Phys. Rev. Letters, Vol. 3, No. 9, 418-19 (Nov. 1, 1959).

In several cases a large nuclear polarization has been produced in a fluid by pumping with microwave radiation in resonance with paramagnetic centres near a solid–fluid interface. The number of such paramagnetic sites per unit volume of the sample is often very small. Only nuclei in the fluid molecules nearest to the paramagnetic centres are directly experiencing the spin flips which give rise to such an Overhauser type of effect. Therefore molecular diffusion must play an essential role in these phenomena. In this note the authors derive a theoretical expression for the total nuclear polarization, which contains the fluid volume as an independent variable. The authors conclude that the study of spin pumping in these systems should give rather detailed information concerning the relaxation at the surface. J.M.Baker

532.7 : 538.27

90 ANOMALOUS LOSS OF RESOLUTION OF PARAMAGNETIC RESONANCE HYPERFINE STRUCTURE IN LIQUIDS. G.E.Pake and T.R.Tuttle, Jr.
Phys. Rev. Letters, Vol. 3, No. 9, 423-5 (Nov. 1, 1959).

Hausser (Abstr. 11252 of 1959) has recently observed a remarkable temperature dependence in the resolution of hyperfine splittings for paramagnetic molecules in liquid solution. Typically, he finds that increasing temperature from a point of high solvent viscocity ultimately brings out a well resolved structure which surprisingly blurs and disappears at still higher temperatures. The authors propose that the initial appearance of structure can be accounted for on the theory of motional narrowing by supposing that the inverse of the correlation time, which increases with T, is greater than the anisotropic part of the hyperfine interaction frequency, so that one is left with just a well resolved isotropic part. The broadening at higher temperatures is explained by supposing that in a collision between two paramagnetic ions the mutual exchange interaction interrupts their resonant precession, and if the frequency of interruption, which is proportional to T, becomes large enough the line will be broadened. J.M.Baker

532.7 : 538.27

91 SOLVENT EFFECTS IN THE PROTON MAGNETIC RESONANCE SPECTRA OF PHENOLS.
I.Gränacher and P.Diehl.
Arch. Sci. (Geneva), Vol. 12, Special No., 238-42 (1959).

1959 Maxwell–Ampere Conference paper (see Abstr. 11542 of 1959). The concentration dependent shift of proton resonance frequency for the O-H group in phenol, p-chlorophenol and o-chlorophenol in the solvents, dioxane, ethyl ether, acetone, cyclohexane, carbon tetrachloride, benzene and thiophene has been measured. The observed results for phenol and p-chlorophenol show that the solvents may be put into three groups: a first group, proton acceptors, producing a shift to lower magnetic fields, a second group showing characteristic dilution shift behaviour, and a third group showing a shift to higher magnetic fields. The behaviour of o-chlorophenol exhibits significant differences, which are discussed. S.A.Ahern

MECHANICS OF GASES

533.1

92 VISCOSITY MEASUREMENTS OF GASES BETWEEN 20 AND 80°K.
J.M.J.Coremans, J.J.M.Beenakker, A.van Itterbeek and P.Zandbergen.
Bull. Inst. Internat. Froid, Annexe 1958-1, 281-7.

The construction of an apparatus with a temperature stability of about 0.01°K is described. With it the viscosities of He, H_2, D_2, and Ne were measured in the temperature range from 20° to 60°K. R.Schnurmann

533.1

93 OUTFLOW OF A GAS FROM A CONTAINER WITH WALLS ENCLOSING A SMALL ANGLE $2\theta_0$.
A.Arÿnov.
Dokl. Akad. Nauk SSSR, Vol. 123, No. 1, 43-6 (1958). In Russian.

A study is made of a gas with subcritical velocity and of a liquid with critical velocity. J.M.Zarzycki

533.1

94 POTENTIAL STEADY RELATIVISTIC GAS FLOWS. F.I.Frankl'.
Dokl. Akad. Nauk SSSR, Vol. 123, No. 1, 47-8 (1958). In Russian.

Discusses a general case of a three-dimensional steady-state relativistic flow, and then a case of an extreme-relativistic gas. See also Abstr. 5856 (1955), 1967 (1957) and 5711 (1958). J.M.Zarzycki

533.6

95 ON AN ELECTRONIC METHOD FOR MEASUREMENT OF THE MEAN VELOCITY OF FLOW OF A GAS.
R.Brun and C.Chartier.
C.R. Acad. Sci. (Paris), Vol. 248, No. 23, 3264-5 (June 8, 1959). In French.

A method has been developed in which a pulse of ionization is produced by a means of X-rays at a discrete point in the flow. The ionization is then detected at a further point and the time measured in conjunction with a thyratron circuit. The method appears to be quite accurate. T.C.Toye

GASEOUS STATE

533.7

96 BOUNDARY CONDITIONS IN GENERALIZED HYDRODYNAMICS. I.I.Ol'khovskii.
Dokl. Akad. Nauk SSSR, Vol. 123, No. 2, 262-5 (1958). In Russian.

By applying the kinetic theory to the collisions of gas molecules with macroscopic walls, a relation between the distribution functions of the incident and reflected molecules is derived. This relation is formulated as generally as possible, so that any kind of movement and arbitrary temperatures of the surface are taken into account and that elastic and inelastic collisions are considered. The result is re-formulated in terms of those quantities which are employed in the author's generalized hydrodynamics. With applications to acoustics in mind, the author gives expressions applicable to one-dimensional flow and simplifies ("linearizes") them so that they apply only to the neighbourhood of stationary conditions. R.Eisenschitz

533.7 : 534.32

97 A PARTICULAR CASE OF A LINEAR BOUNDARY PROBLEM IN GENERALIZED HYDRODYNAMICS. A CONTRIBUTION TO THE THEORY OF THE ULTRASONIC INTERFEROMETER. I.I.Ol'khovskii.
Dokl. Akad. Nauk SSSR, Vol. 123, No. 5, 821-4 (1958). In Russian.

The theory of acoustic interferometry has, so far, developed on the basis of the ordinary acoustics. According to the author this approach is insufficient if the frequency is of the order of magnitude of the pressure divided by the coefficient of viscosity. From the results of the preceding abstract, expressions are obtained which may claim greater accuracy. R.Eisenschitz

533.7

98 INTEGRATED FORM OF THE BOLTZMANN EQUATION AND ITS APPLICATION TO GAS DYNAMICS. T.Koga.
Phys. of Fluids, Vol.2, No.5, 580-2 (Sept.-Oct., 1959).

Proposes solving Boltzmann's equation by integrating along the trajectories the particles would move along in the absence of collisions. O.Penrose

533.7

99 A MODEL OF MOLECULAR BINARY COLLISION. T.Koga.
Phys. of Fluids, Vol. 2, No. 5, 580 (Sept.-Oct., 1959).

It is pointed out that the collision integral in Boltzmann's equation is particularly simple if the molecules interact like hard spheres whose area is inversely proportional to the relative velocity. O.Penrose

533.7

100 THE INFLUENCE OF THE DENSITY ON THE THERMAL DIFFUSION IN GAS MIXTURES OF GASES AT LOW TEMPERATURES.
H.van Ee, A.van Itterbeek and J.J.M.Beenakker.
Bull. Inst. Internat. Froid, Annexe 1958-1, 275-9.

A thermal diffusion apparatus consisting of two bulbs with short and comparatively wide connecting tube was built. Each of the bulbs can be maintained at a constant temperature, while the low temperature part of the connecting tube was lagged with cotton so as to reduce the effect of a change of level of the cooling bath. Katharometers with thermistors were used to measure changes in concentration. A sensitivity better than 0.02% is aimed at. So far sensitivities of the order 0.04% were attained in H_2-N_2 and in H_2-He mixtures. R.Schnurmann

533.7

101 GAS DIFFUSION IN POROUS MEDIA. R.J Millington.
Science, Vol. 130, 100-2 (July 10, 1959).

A method is proposed for deriving a characteristic determining flow in porous systems. This characteristic combines both area and path-length factors used by earlier authors. For a gas, diffusive flow is proportional to the 4/3 power of the gas-filled porosity, and this function is derived from consideration of the planar distribution of spherical pores and the interaction of two adjacent planes.

533.7

102 TEMPERATURE OF NITROGEN AND AIR BEHIND A SHOCK WAVE.
F.S.Faizullov, N.N.Sobolev and E.M.Kudryavtsev.
Dokl. Akad. Nauk SSSR, Vol. 127, No. 3, 541-4 (July 21, 1959). In Russian.

The velocity of a shock wave in a shock tube was measured by an ionization method, and the temperature by the reversal of the D sodium lines or of the Ba^+ 4554 A line. The distribution of velocity agreed with the results of other authors, and the temperature of distribution was in satisfactory agreement with theory. See also Abstr. 3952 (1958). R.F.S.Hearmon

533.7

103 PROPERTIES OF DYNAMIC ADIABATS IN THE CASE OF A DOUBLE DISCONTINUITY: SHOCK WAVE–COMBUSTION WAVE. J.Brossard and N.Manson.
C.R. Acad. Sci. (Paris), Vol. 249, No. 3, 372-4 (July 20, 1959). In French.

Detailed consideration of the p–v diagram describing a detonation process, taking into consideration the difference between the state just behind the shock and that just in front of the combustion wave. Correspondence with the classical description is discussed. J.Hawgood

533.7 : 536.23

104 THE THERMAL CONDUCTIVITIES OF MIXTURES OF RARE GASES AT 29° C AND AT 520° C. H. von Ubisch.
Ark. Fys., Vol. 16, Paper 7, 93-100 (1959).

The present investigation was aimed principally at the triple mixtures of He–Kr–Xe, which may occur in fuel elements of certain atomic reactors. However, because heat conductivities of mixtures of rare gases and conductivities at elevated temperatures altogether have been very little investigated, it was decided to extend the programme by including all the binary mixtures between the common rare gases He, Ne, A, Kr, and Xe and to measure at 29° C and at 520° C.

533.7

105 RATIO (C_p/C_V) FOR PERCHLORYL FLUORIDE FROM VELOCITY OF SOUND MEASUREMENTS.
J.L.Margrave and R.P.Wendt.
J. chem. Phys. Vol. 31,, No. 3, 857 (Sept., 1959).

At 24° C, γ (ClO_3F) = 1.12 ± 0.01 from sound velocity determinations compared with 1.145 from spectroscopic data assuming an ideal gas. G.I.W.Llewelyn

VACUUM PHYSICS

533.5

106 NEW TECHNIQUES IN THE ATTAINMENT OF HIGH VACUA. R.A.Rapp.
Rev. sci. Instrum., Vol. 30, No. 9, 839-40 (Sept., 1959).

Describes a method for measuring the rates of evaporation from metal crystals in a vacuum. To reduce the residual pressure in the vacuum system, containing a greased joint, to 10^{-7} to 10^{-9} mm Hg by means of an oil diffusion pump, the system was flamed, a getter used and the greased joint cooled to −78° C or to −195° C. J.Dutton

533.5

107 IMPORTANT CHARACTERISTICS OF A NEW TYPE OF GETTER–ION PUMP. R.L.Jepson.
Vide, Vol. 14, 80-94 (March-April 1959). In French and English.

Reviews the basic operation of a getter–ion pump and describes some experiments to establish the relation between pumping speed and voltage, magnetic field, pressure and the nature of the gas. It also describes rough pumping techniques employing "refrigerated absorption". R.D.Hudson

533.5

108 HIGH-SPEED NONREFRIGERATED ISOLATION TRAPS FOR ULTRA HIGH-VACUUM SYSTEMS. M. A. Biondi.
Rev. sci. Instrum., Vol. 30, No. 9, 831-2 (Sept., 1959).

Describes a new type of a nonrefrigerated isolation trap using zeolite (alkali metal aluminosilicate) or activated alumina, providing a much higher conductance and remaining effective for much longer periods of time than the conventional copper trap. It was found, testing the traps, that after baking for 8 hrs. at 450° C with operating gauge, the pressure fell to about 3×10^{-10} mm Hg for zeolite and to 1×10^{-10} mm Hg for alumina and remained there for the duration of the tests (75 days for zeolite and 100 days for alumina), while a 6 cm long copper trap tested at similar conditions remained effective for about 20 days. J. M. Zarzycki

533.5

109 ON THE ELECTRICAL "CLEAN-UP" OF GASES IN THE HIGH-VACUUM PRESSURE RANGE. II. G.Strotzer.
Z. angew. Phys., Vol. 11, No. 6, 223-34 (June, 1959). In German.

Previous calculations by the author (Abstr. 7755 of 1958) are extended to include the clean-up effect of uncharged particles. The results show that there is usually a quadratic relation between rate of clean-up and intensity of ionization.
A.E.I. Research Laboratory

533.5

110 CLEANING OF SLIDES FOR VACUUM DEPOSITION. J.P.Reames.
Rev. sci. Instrum., Vol. 30, No. 9, 834 (Sept., 1959).

The author describes a method of removing all ionizable salts,

acids, etc., from glass slides. Degreased slides are placed in a tank and demineralized water is pumped through the system. Organic, inorganic and sub-micron filters are incorporated. Cleanliness of the slide is monitored by measuring the electrical resistance of the filtered water. T.Mulvey

533.5

111 RADIO-FREQUENCY INDUCTION VACUUM FURNACE FOR CLEAN TARGET PREPARATION.
R.A.Moore, L.W.Seagondollar and R.B.Smith.
Rev. sci. Instrum., Vol. 30, No. 9, 837-8 (Sept., 1959).
Describes an experimental arrangement used. J.Dutton

533.5 : 536.48

112 SIMPLE MECHANICAL PRESSURE CONTROLLER FOR LIQUID-HELIUM CRYOSTATS. E.J.Walker.
Rev. sci. Instrum., Vol.30, No.9, 834-5 (Sept., 1959).
The controller consists of a length of thin walled rubber tubing situated in the pumping line and surrounded by a container in which a reference pressure is maintained. The rubber tubing is slightly longer than the section of rigid tube it replaces so that it can move in and out freely. Two such controllers have been made for 1" and 3" lines respectively. The first operated successfully to 1.02 mm Hg (1.27°K) with a constancy of 0.2 mm Hg above 50 mm Hg and to better than 0.02 mm Hg below this. The larger controller operated successfully to 0.27 mm Hg (1.1°K). F.E.Hoare

533.5 : 537.53

113 DIRECTED GLOW DISCHARGE.
M.Liebson.
Rev. sci. Insrum., Vol.30, No.9, 833-4(Sept., 1959).
In order to restrict the glow discharge in a vacuum coating plant to the articles to be coated, the high potential electrode is enclosed in a glass tube whose open end is directed at the required area. This ensures a tightly adhering coating where it is required and a loose coating on the rest of the apparatus. T.Mulvey

VIBRATIONS · ACOUSTICS

534.1

114 PASSAGE OF NONLINEAR OSCILLATORY SYSTEM THROUGH THE RESONANCE. B.V.Chirikov.
Dokl. Akad. Nauk SSSR, Vol. 125, No. 5, 1015-18 (April 11, 1959).
In Russian.
The method described enables one to obtain an approximate (1st order) solution directly from the Hamiltonian of the system, with one degree of freedom; the system is excited periodically in the vicinity of the resonance and the nonlinearity enters into the Hamiltonian as a perturbation term, which includes excitation and is multiplied by a small parameter. The method is exemplified on a system for which the phase Ψ, of the energy change, satisfies $\Psi'' = 1 - A \cos \Psi$, where A is proportional to the impressed frequency. J.K.Skwirzynski

534.1

115 SECOND-ORDER INSTRUMENTATION SYSTEMS WITH FREQUENCY-DEPENDENT STIFFNESS AND DAMPING.
E.Rule, F.J.Suellentrop and T.A.Perls.
J. Acoust. Soc. Amer., Vol. 31, No. 11, 1457-62 (Nov., 1959).
The theory of the dynamic properties of thin fluid films is reviewed and it is shown how these properties can be used to introduce frequency-dependent damping and stiffness factors into the equations governing the response of second-order instrumentation systems such as transducers for the measurement of dynamic accelerations, vibration, pressure, sound, etc. By proper design, the frequency-dependent nature of these factors can be utilized to provide substantial improvement in the frequency-response characteristics of such systems over the characteristics obtainable with the usual second-order system with constant viscous damping. For the specific case when the fluid is air at normal temperature and pressure, curves are given from which transducers can be designed to have optimum frequency-response characteristics.

534.11

116 LARGE AMPLITUDE MOTION OF A STRING.
J.B.Keller.
Amer. J. Phys., Vol. 27, No. 8, 584-6 (Nov., 1959).
The motion of a string is investigated without assuming that the amplitude of the motion is small or that the motion is purely transverse. By assuming a special stress–strain law for the string material, it is found that the three components of motion are independent and that each component satisfies the usual linear wave equation. The derivation of these exact results seems to be simpler than the usual approximate derivations. It is also shown that the special stress–strain law employed is the only one for which purely transverse motion is possible.

534.12

117 THE EFFECT OF A VIBROMETER ON THE MOTION OF AN OSCILLATING SURFACE. I.I.Klyukin.
Akust. Zh., Vol. 5, No. 1, 38-44 (1959). In Russian.
The effect of the finite mass of the vibrometer on the transverse oscillations of infinite rods and sheets are considered and expressions given for the resulting weakening of the vibrations. It is shown that, at medium and high frequencies, the latter can attain high values. At the resonance frequency of the movable system of the vibrometer, an additional weakening occurs as the vibrometer acts as an antivibrator. The case is also considered of a vibrometer weighing a few grammes and its effect on the longitudinal oscillations of materials of small modulus, such as rubber and plastics, and for a steel rod of possible practical size. For the first the effect is smaller than for transverse vibrations but still large, whilst for acoustic frequencies in steel the effect is negligibly small. Theoretical paper. C.R.S.Manders

534.12

118 A PROBLEM ON STRESS WAVES IN AN INFINITE [ISOTROPIC] ELASTIC PLATE. K.B.Broberg.
K. Tekn. Högsk. Handl., No. 139, 26 pp. (1959).
A plate subjected to a transverse impulsive load at one point of its upper surface is considered. The displacement at that point on the lower surface that is opposite to the point of impact is calculated and evaluated numerically. Comparison with experimental results is made. The solution of the problem is found by using a method introduced by Cagniard (1939). The corresponding line-load problem is considered. Both in the case of the point load and in the case of the line load, displacements in a semi-infinte solid are found as intermediate results.

534.13

119 SURVEY OF THERMAL, RADIATION, AND VISCOUS DAMPING OF PULSATING AIR BUBBLES IN WATER.
C.Devin, Jr.
J. Acoust. Soc. Amer., Vol. 31, No. 12, 1654-67 (Dec., 1959).
A theoretical discussion is presented on the fundamental processes by which pulsating gas bubbles in liquids dissipate their energy. The survey is limited to the case where the amplitude of the volume pulsations are assumed to be sufficiently small that the pulsations may be described by linear equations. A portion of the energy of the bubble system is lost by the radiation of spherical sound waves; a part is lost by heat conduction due to the polytropic compressions and expansions of the enclosed gas, and a portion is lost by viscous dissipation attributed to viscous forces acting at the gas–liquid interface. A survey is made of the procedures for measuring the resonant damping constant as described in the methods of successive oscillations, width of the resonance response, standing-wave ratios, and resonance absorption. Experimental results verify that the damping at resonance is due to thermal and radiation, and possibly viscous damping.

534.2 : 538.56

120 RELATIONS BETWEEN THE VARIATIONS IN AMPLITUDE AND PHASE IN THE PROPAGATION OF VIBRATORY PHENOMENA. J.C.Simon and G.Broussaud.
C.R. Acad. Sci. (Paris), Vol. 248, No. 25, 3693-5 (June 22, 1959).
In French.
An attempt is made to establish whether the observed phase relationships in certain types of aeriel have a general applicability in the field of acoustics, electromagnetism and mechanical vibrations by considering the problem of a 3-branch junction of which 2 branches are the extremities of the same feeder from which the 3rd branch is able to extract energy. It is shown that the change in phase resulting from a small transfer of energy from one location to another is always accompanied by a phase advance in a "series" junction and a phase retardation in a "shunt" junction.
H.J.H.Starks

534.2 : 538.56

121 INFLUENCE OF THE ENVIRONMENT ON THE WAVE TRANSMISSION OF ENERGY: RESONANCE AND ELAXATION. R.B.Lindsay.
mer. J. Phys., Vol. 28, No. 1, 67-75 (Jan., 1960).

This paper reviews the influence of the environment on the mission and absorption of radiation energy, both elastic and electro-agnetic. Attention is called to the loading of wave sources which independent of frequency. Of those influences which are frequency pendent, resonance and relaxation are the most important. These e compared and their similarities and differences noted. Numer-us illustrations are presented.

534.21

122 THE FIELD OF A PULSE EMITTER IN AN UNDER-WATER SOUND CHANNEL. V.A.Polyanskaya.
kust. Zh., Vol. 5, No. 1, 91-100 (1959). In Russian.

Theoretical paper considering the propagation of sound from a ulsed, point radiator. Calculations are made assuming normal aves and employing phase integral approximation for various shapes f pulse. It is shown that there is a region of cylindrical decay of ound strength dependent upon the pulse shape, a result which is terpreted by ray theory. C.R.S.Manders

534.21

123 THE PROPAGATION OF A SOUND PULSE IN AN UNDERWATER SOUND CHANNEL.
.S.Ageeva.
kust. Zh., Vol. 5, No. 2, 146-50 (1959). In Russian.

An analysis is given of the shape of signal for propagation of a ound pulse in an underwater sound channel. The recording of the alse is compared with that given by a ray diagram corresponding the conditions of the experiment. Using a square-wave pulse of sec duration and distances of propagation up to 20 km, it is found at at shorter distances the c.r.o. signal tends to become double whilst longer distances the shape is notably more complicated.
C.R.S.Manders

534.22

124 MEASUREMENTS ON THE VELOCITY OF SOUND IN LIQUID OXYGEN AND NITROGEN AND MIXTURES OF TROGEN AND OXYGEN UNDER HIGH PRESSURES.
.van Itterbeek and W.van Dael.
ull. Inst. Internat. Froid, Annexe 1958-1, 295-306.

Using an acoustical interferometer, measurements on the locity of sound in liquid oxygen and liquid nitrogen at 78° and 0°K were made at pressures of up to 75 atmospheres. The sults are given and, in each case, show a linear increase of locity with increasing pressure. Similar measurements were so carried out on liquid air and on oxygen–nitrogen mixtures ith similar linear results; it is suggested that velocity measure-ents could be used to determine the composition of such a ixture. Density–pressure measurements are to be made so that iabatic compressibilities can be calculated. L.Mackinnon

534.23

125 EMISSION OF ULTRASONIC WAVES THROUGH PLANE-PARALLEL LAYERS. D.B.Dianov.
kust. Zh., Vol. 5, No. 1, 31-7 (1959). In Russian.

In ultrasonic studies of solids one or more intermediate layers re usually placed between a vibrator or a receiver and the solid in der to improve the efficiency of energy transfer. Such intermedi-ce layers and their effect on emitted radiation are discussed. It is nown that, if a quarter-wave layer is used between a piezovibrator nd a medium, the emission intensity at a particular frequency may e increased, provided the layer has lower acoustic impedance than ae impedance of the medium. Larger increases of intensities at nosen frequencies can be achieved by the use of two or more layers. or this purpose, an odd number of intermediate layers is usually mployed for irradiation of solids, while an even number of such yers is more convenient in irradiation of liquids. The theoretical quations were checked by comparing them with experimental re-ults obtained with a vibrator emitting directly into water and mitting via an intermediate double layer consisting of water and a lass plate; good agreement was obtained between theory and experi-ent. A.Tybulewicz

534.23

126 PROPAGATION OF BAND-LIMITED NOISE IN A LAYERED WAVE GUIDE. C.S.Clay.
. Acoust. Soc. Amer., Vol. 31, No. 11, 1473-9 (Nov., 1959).

The normal mode solution of the problem of the radiation field of a simple harmonic point source in a layered waveguide is extended to the case of a band-limited noise source. This theory is used to calculate the radiation field of a simple harmonic point source and a point noise source in shallow water over a thick layer of unconsolidated sediments, and the calculations are compared with experimental data. The experimental dependence of the acoustical pressure upon source distance is in agreement with that calculated from the theory.

534.23

127 DISPERSION OF SOUND VELOCITY AND THE PROPAGATION OF HYPERSOUND IN LIQUIDS.
M.S.Pesin and I.L.Fabelinskii.
Dokl. Akad. Nauk SSSR, Vol. 122, No. 4, 575-7 (1958). In Russian.

Measurements made of ultrasonic absorption in chloroform and methylene bromide at 30 Mc/s showed a square law absorption to occur. The relaxation time was of the order $\tau \approx 5.2 \times 10^{-9}$ sec, and hence a dispersion of sound velocity distribution of observable size was to be expected. The authors used a Fabry–Perot etalon crossed with an ISP-51 spectrograph arrangement as described earlier [Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 27, 538 (1953)]. A table is given of all the parameters of the propagation of hypersound in methylene bromide and methylene chloride. C.R.S.Manders

534.23

128 FREQUENCY RESPONSE OF AN ACOUSTIC AIR-JET GENERATOR. J.C.Gravitt.
J. Acoust. Soc. Amer., Vol. 31, No. 11, 1516-18 (Nov., 1959).

The mechanism which gives rise to the intense vibrations of an acoustic air-jet generator is investigated both experimentally and theoretically. The results indicate that the mechanism for establishing the vibrations in the generator consists of pressure instabilities in the nozzle air stream which act as the source of the forced oscillations of an air plug in the resonator cavity.

534.23

129 PERFORMANCE OF HIGH-FREQUENCY BARIUM TITANATE TRANSDUCERS FOR GENERATING ULTRASONIC WAVES IN LIQUIDS. H.J.McSkimin.
J. Acoust. Soc. Amer., Vol. 31, No. 11, 1519-22 (Nov., 1959).

A study is made of high frequency (10 Mc/s) barium titanate transducers radiating into water, with bandwidth and efficiency being of principal concern. Optimum electrical amping alone is considered; however, it is demonstrated that the introduction of an intermediate $\frac{1}{4}$ wavelength thick composite mechanical element results in superior performance. Of the units constructed, the best exhibited a frequency bandwidth (half-power points) of 44% with 4 dB midband loss (equivalent insertion loss on a 2 transducer basis). Focusing radiators, as well as plane, were tested.

534.23

130 SPHERICAL BARIUM TITANATE PRESSURE RECEIVERS OF AIR SHOCK WAVES.
V.P.Makushkin and A.V.Mishuev.
Akust. Zh., Vol. 5, No. 1, 64-9 (1959). In Russian.

The mode of functioning of a spherical piezoelectric shell is analysed and the principles involved in the choice of shell thickness considered. The paper describes a spherical pressure receiver of radius 1.9 mm supported in a thin conical holder made of rubber for damping out the natural elastic waves. Results are given for tests with the apparatus for pressures varying from the acoustic level up to 3.5 kg/cm^2. It is found that up to about 2 kg/cm^2 the record obtained is undistorted but for higher pressures it is necessary to apply a correction to the readings. C.R.S.Manders

534.23

131 PROPAGATION OF A PRESSURE PULSE IN A COMPRESSIBLE FLOW. A.Powell.
J. Acoust. Soc. Amer., Vol. 31, No. 11, 1527-35 (Nov., 1959).

A one-dimensional treatment of the propagation of a pressure pulse through a channel carrying a compressible flow is given. The method consists of summing the multiple linear reflections of increasing order, the "transmission" and "reflection" coefficients then being given in the form of power series whose terms depend only on the entry and exit Mach numbers of the mean flow. The series fails to converge under certain circumstances, but there is nothing corresponding to this in the equivalent results obtained from "before" and "after" steady-state considerations. Both methods are shown to fail at a

sonic throat, where it is suggested that the assumption of one-dimensional perturbations is no longer tenable.

534.26

132 THE SCATTERING OF SOUND CAUSED BY UNEVENNESSES OF A DISCONTINUITY LAYER IN THE SEA. G.D.Malyuzhinets.

Akust. Zh., Vol. 5, No. 1, 70-6 (1959). In Russian.

Theoretical paper considering the scattering of a sound wave propagated close to the transition layer between waters of different temperatures. Some simple assumptions are made concerning the statistical nature of the internal gravitational waves that occur in this transition layer and the intensity of reverberation and the scattering coefficient are calculated approximately.

C.R.S.Manders

534.26

133 THE SCATTERING OF SOUND WAVES IN IRREGULAR WAVEGUIDES. A.D.Lapin.

Akust. Zh., Vol. 4, No. 3, 267-74 (1958). In Russian.

A modification of Rytov's method (Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 2, 223-59, 1937) is put forward for calculating the scattering in irregular waveguides when the scattered field is not small compared with the incident one. Effect of small fluctuations in the parameters of the medium filling the waveguide is considered, also the effect of roughness of the waveguide walls. [English translation in: Soviet Physics–Acoustics (New York), Vol. 4, No. 3, 272-9 (July-Sept., 1958)].

C.R.S.Manders

534.3

134 ELASTIC MODULUS AND DENSITY: SIGNIFICANT PARAMETERS OF THE SPECTRUM OF AN ISOLATED HARMONIC STRING. É. Leipp.

C.R. Acad. Sci. (Paris), Vol. 248, No. 23, 3278-80 (June 8, 1959). In French.

The musical quality of violin strings was correlated with the longitudinal vibrations excited concurrently with the transverse modes.

H. D. Parbrook

534.32 : 533.7

ULTRASONIC INTERFEROMETER THEORY. See Abstr. 97

534.32

135 TUNING PREFERENCES FOR PIANO UNISON GROUPS. R.E.Kirk.

J. Acoust. Soc. Amer., Vol. 31, No. 12, 1644-9 (Dec., 1959).

Unison strings of a concert grand piano were tuned to five "unison" conditions. The conditions were "zero-beat" tuning and the upper string of three string unison groups tuned sharp and the lower string tuned flat by $\frac{1}{2}$, 1, 2, and 3 cents relative to the centre string. Magnetic tape recordings were made of the piano tuned under these conditions. These recordings in the form of a paired comparison preference test were presented to musically trained and untrained subjects. The most preferred tuning conditions for three string unison groups as recorded and reproduced from magnetic tape, are 1 and 2 cents maximum deviation among strings. Musically trained subjects prefer less deviation in tuning among unison strings than do untrained subjects. Close agreement was found between the subject's tuning preferences and the way artist tuners actually tune piano unison strings.

534.37

136 TRANSIENT BEHAVIOR OF THE DYNAMIC ABSORBER. J.C.Snowdon.

J. Acoust. Soc. Amer., Vol. 31, No. 12, 1668-75 (Dec., 1959).

The ability of a dynamic absorber of optimum design to reduce the transient motion of resiliently mounted equipment is discussed theoretically. The motion of the mounted item is assumed to result from step-like foundation displacements possessing a wide range of rise times. The absorber mass is attached to the mounted item by a viscously damped spring. It is shown that the transient motion of the mounted item is characterized by the rapid manner in which it decays with time. In general, if the contents of a resiliently mounted item are to receive the greatest possible protection from damage due to shock, the maximum acceleration and the maximum displacement and relative displacement of the mounted item should be simultaneously small. These are conflicting requirements, but they are fulfilled more closely than is possible with a simple mounting when a dynamic absorber of mass comparable to that of the mounted item is utilized.

534.39 : 535.8

137 A SPECTROPHONE WITH A MULTIPLE PASSAGE OF RADIATION. P.V.Slobodskaya.

Optika i Spektrosk., Vol. 5, No. 3, 342-3 (1958). In Russian. English summary: PB 14104T-7, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

See Abstr. 4575 (1938) and 2868 (1959). Describes a method of amplification of the signal when working with weak absorption bands (when the spectrophone is used for determining the coefficients of absorption probability and of the relaxation period of the vibration state of molecules); this method consists in making the radiation pass a number of times through the chamber of the receiver. Diagrams of the receiver and of the path of radiation are given.

F.Lachman

534.39 : 536.25

138 THE EFFECT OF ACOUSTIC STREAMING ON THE PROCESS OF CONVECTIVE HEAT EXCHANGE. P.N.Kubanskii.

Akust. Zh., Vol. 5, No. 1, 51-7 (1959). In Russian.

Reasons are given explaining the enhancement of heat emission on account of vibrations during natural convection in the experiments of Martinelli and Boelter (1939) and Lemlich (1955). The results are presented of an experimental study of the heat transfer from the wall of a heated cylinder to the surrounding air with a standing acoustic wave of large amplitude under conditions of natural and forced convection. For intensities of the order 0.03 to 0.16 W/cm^2 and frequencies from 8 to 30 kc/s, a five-fold increase of intensity is possible. Similarity criteria are found for the phenomena under investigation, also the relevant equations, and an explanation is given of results obtained.

C.R.S.Manders

534.39 : 541.18

139 THE COAGULATION OF AEROSOL PARTICLES IN AN ACOUSTIC FIELD UNDER THE INFLUENCE OF OSEEN'S HYDRODYNAMIC FORCES. S.V.Pshenai-Severin.

Dokl. Akad. Nauk SSSR, Vol. 125, No. 4, 775-8 (April 1, 1959). In Russian.

It is known that aerosols coagulate under the influence of ultrasonic waves. In investigating this effect, so far only the inertial forces of the moving air were taken into account. The author gives reasons why viscous forces ought to be considered in this context. A quantitative estimate is obtained of the difference of the forces acting on two particles in the field of a sound wave, one of which is located in the wake of the other. The resulting relative displacement, which may lead to coagulation, is deduced from Oseen's linear approximation to the equations of hydrodynamics. As a result, the relative displacement is graphically shown as a function of the frequency and amplitude of the incident wave.

R.Eisenschitz

534.41 : 535.42

140 DIFFRACTION OF LIGHT ON HARMONICS OF AN ULTRASONIC WAVE DISTORTED IN THE PROCESS OF PROPAGATION IN A LIQUID. I.G.Mikhailov and V.A.Shutilov.

Akust. Zh., Vol. 5, No. 1, 77-9 (1959). In Russian.

Distortion of ultrasonic waves of finite amplitude on propagation in a liquid is equivalent to the appearance of second and higher harmonics, which can be observed by means of the optical diffraction apparatus used by the authors. This apparatus consisted of a quartz plate excited at 583 kc/s and an optical system for observation of the diffraction patterns. The quartz radiator was placed in a bath of water and a particular harmonic was separated out by means of an acoustical filter, placed between the radiator and the region where a light beam was passed through the water bath. The diffraction patterns obtained for the second, third and fourth harmonics, as well as for the unfiltered wave, are reproduced. The latter pattern was strongly asymmetric because of distortions in the unfiltered ultrasonic wave, which are produced in the process of propagation through water.

A.Tybulewicz

534.61

141 MEASUREMENTS OF ACOUSTIC RADIATION FORCE. K.Budal, E.Höy and H.Olsen.

J. Acoust. Soc. Amer., Vol. 31, No. 11, 1536-8 (Nov., 1959).

The acoustic radiation force of a plane wave impinging on a rigid sphere of diameter 10 cm and on a circular disk of diameter 7.4 cm was measured in the wavelength interval 4 to 40 cm. The agreement with theory is satisfactory.

534.83

142 SURFACE AND GROOVE NOISE IN DISK RECORDING MEDIA. I. D.H.Howling.

. Acoust. Soc. Amer., Vol. 31, No. 11, 1463-72 (Nov., 1959).

A theoretical and experimental investigation into the causes nd mechanism of playback surface and groove noise of recording nedia was made. It is shown that such noise can be considered as rising from the random superposition of voltage pulses produced y local changes in the number and size distribution of welded riction junctions or asperities supporting the playback stylus load. A generalized noise equation, involving the physical parameters of he recorded medium and the playback stylus, was derived and hows reasonable agreement with the measured playback noise pectra for several cold-flowing and rigid plastic surfaces. From he noise equation emerges a concept of modulation noise and pre- diction of its dependence on modulation velocity. Examination of he playback noise level as a function of recording and playback onditions was also included. It is also shown that surface noise neasurements can be used to give information concerning the n/a atio associated with the theory of friction. The measured lower imit of wide band playback noise for most plastic surfaces corres- onds to an equivalent r.m.s. lateral noise velocity of 10^{-2} cm/sec r equivalent lateral noise amplitude of 1 μin. peak at a linear elocity of 15 cm/sec. The equivalent roughness is thus half of hat associated with an optical flat. Using this information, it is hown that at 1000 lines/in. information density a signal-to-noise atio of 50 dB at a linear velocity of 15 cm/sec should be realized.

534.83

143 SURFACE AND GROOVE NOISE IN DISK RECORDING MEDIA. II. D.H.Howling.

. Acoust. Soc. Amer., Vol. 31, No. 12, 1626-38 (Dec., 1959).

For Pt I see preceding abstract. A theoretical and experimental nvestigation into the causes and mechanism of playback surface and roove noise of recorded media was made. It is shown that such oise can be considered as arising from the random superposition f voltage pulses produced by local changes in the number and size istribution of welded friction junctions or asperities supporting the layback stylus load. A generalized noise equation, involving the hysical parameters of the recorded medium and the playback tylus, was derived and shows reasonable agreement with the easured playback noise spectra for several cold-flowing and rigid lastic surfaces. From the noise equation emerges a concept of odulation noise and prediction of its dependence on modulation elocity. Examination of the playback noise level as a function of ecording and playback conditions was also included. It is also shown hat surface noise measurements can be used to give information oncerning the n/a ratio associated with the theory of friction. The easured lower limit of wide band playback noise for most plastic urfaces corresponds to an equivalent r.m.s. lateral noise velocity f 10^{-2} cm/sec or equivalent lateral noise amplitude of 1 microinch eak at a linear velocity of 15 cm/sec. The equivalent roughness is hus half of that associated with an optical flat. Using this informa- ion, it is shown that at 1000 lines/in. information density a ignal/noise ratio of 50 dB at a linear velocity of 15 cm/sec should e realized.

534.84

144 FREQUENCY AND DIRECTIONAL DISTRIBUTION OF NORMAL MODES OF VIBRATION IN A RECTANGULAR ROOM. Maa Dah-You.

cci. Record (China), New Series, Vol. 1, No. 6, 399-404 (Dec., 1957).

These are determined theoretically for a non-absorbing ectangular room. An optimum ratio of length to breadth to height avours random frequency and directional distributions.

H.D.Parbrook

534.84

145 MEASUREMENT OF SOUND DIFFUSION IN REVERBERATION CHAMBERS. M.R.Schroeder.

. Acoust. Soc. Amer., Vol. 31, No. 11, 1407-14 (Nov., 1959). Also n: Acustica, Vol. 9, 256-64 (1959) [= Akust. Beih., No. 1 (1959)].

This paper describes a variety of methods for the measurement f the diffusion of sound fields in reverberation chambers. Diffusion defined on the basis of the angular distribution of sound energy flux, accordance with the definition that has found its visual expression the "sound hedgehog" of Meyer and Thiele. The theoretical founda- ons of the methods proposed here are: normal mode expansion, the ampling theorem (both in time and two-dimensional space), and ther Fourier or correlation analysis. The quantities to be meas- ured are sound pressures and, in some cases, sound pressure gradients at a number of sampling points on the measuring wall. Results of these measurements are suitably transformed to give the sound energy fluxes for all possible angles of incidence. The accuracy of measurement is determined by the Q, (frequency times reverberation time) of the chamber and is typically of the order of 1°. This extraordinary directivity is achieved without substantial perturbation of the sound field. Methods applicable to both single frequencies and finite frequency bands are described.

OPTICS . PHOTOMETRY

535.1

146 COHERENCE PROPERTIES OF PARTIALLY POLARIZED ELECTROMAGNETIC RADIATION. E.Wolf.

Nuovo Cimento, Vol. 13, No. 6, 1165-81 (Sept. 16, 1959).

This paper is concerned with the analysis of partial polarization from the standpoint of coherence theory. After observing that the usual analytic definition of the Stokes parameters of a quasi-monochromatic wave are not unique, a simple experiment is analysed, which brings out clearly the observable parameters of a quasi-monochromatic light wave. The analysis leads to a unique coherency matrix and to a unique set of Stokes parameters, the latter being associated with the representation of the coherency matrix in terms of Pauli's spin matrices. In this analysis the concept of Gabor's analytic signal proves to be basic. The degree of coherence between the electric vibrations in any two mutually orthogonal directions of propagation of the wave depends in general on the choice of the two orthogonal directions. It is shown that its maximum value is equal to the degree of polarization of the wave. It is also shown that the degree of polarization may be determined in a new way from relatively simple experiments which involve a compensator and a polarizer, and that this determination is analogous to the determination of the degree of coherence from Young's interference experiment.

535.24

147 SOME ASPECTS OF LUMINANCE AND LUMINOUS EMITTANCE. W.A.Hedrich.

Illum. Engng, Vol. 54, No. 8, 512-18 (Aug., 1959).

The relation between the luminance (luminous intensity per unit projected area) of a source and its luminous emittance (luminous flux emitted per unit area) is discussed and the way in which the flux distribution over an illuminated surface depends on the luminance pattern of a source, as well as on the geometry of the system, is explained. The theoretical treatment is illustrated by application to some simple practical cases. J.W.T.Walsh

535.24

148 NEW CLASS OF WIDE-RANGE LOGARITHMIC CIRCUIT FOR A LIGHT-INTENSITY METER.

D.S.Grey, P.Mark and S.Haskell.

J. Opt. Soc. Amer., Vol. 50, No. 1, 40-4 (Jan., 1960).

A new wide-range logarithmic circuit for a light-intensity meter is described. The circuit, consisting only of photoconductors and constant resistors, takes advantage of the inverse power law that the photoconductors obey. The indicator (microammeter) used is of simple linear type: the deflection is proportional to the current. Accordingly the over-all response is logarithmic in light intensity. An experimental unit covering more than four decades of intensity is described. The same principle may be applied to nuclear radiation meters.

535.24

149 NEW REFLECTOMETER AND ITS USE FOR WHITENESS MEASUREMENT. R.S.Hunter.

J. Opt. Soc. Amer., Vol. 50, No. 1, 44-8 (Jan., 1960).

A new 0° 45° blue- and green-light reflectometer has been built with S-4 vacuum phototubes in a ratio-measuring circuit. Where whiteness is of interest, materials are usually yellowish in hue. In these cases, precise reflectance measurements with just the blue and green tristimulus filters are adequate for whiteness determination. Investigators have found that, in general, yellowness detracts from perceived whiteness much more than does greyness. For best correlation with visual rankings, the green-minus-blue reflectance difference corresponding to yellowness should receive four-to-five times the weight of luminous (green) reflectance alone. Because inadequate blue reflectance detracts so strongly from perceived

whiteness, widespread use is now made of blue fluorescing dyes for the whiteness enhancement of textiles, papers and plastics. These "fluorescent brighteners" absorb in the near ultraviolet and fluoresce in the blue. An ultraviolet-absorbing filter in the new instrument may be alternated between the sample-viewing and incident light beams to include, and then exclude,the near-ultraviolet which excites fluorescence. It is thereby possible to obtain a measure of the contribution of these fluorescent brighteners to blue reflectance, and thence to whiteness.

535.24 : 77

150 THE IMPORTANCE OF GRAIN SIZE IN PHOTOGRAPHIC MICROPHOTOMETRY. R.H.Giese and H.Siedentopf.
Z. Astrophys., Vol. 48, No. 4, 269-78 (1959). In German.

A formula for the density fluctuations in photographic plates as a function of density and area was tested with 3 emulsions and circular scanning areas between 15 μ and 150 μ diameter. From this formula the number of discernible grey steps has been calculated for different conditions.

GEOMETRICAL AND INSTRUMENTAL OPTICS SPECTROSCOPY

(Optical spectra and their analysis are included under the appropriate heading, e.g. Atoms, Molecules, Solid-State Physics, etc.)

535.31

151 MODERN GEOMETRICAL OPTICS (BY MAX HERZBERGER). Received by C.Morais.
Atti Fond. Ronchi, Vol. 14, No. 4, 297-374 (July-Aug., 1959). In Italian.

The review consists of a detailed synopsis of parts I to VIII of the book "Modern Geometrical Optics" by Max Herzberger [Pure and Applied Mathematical Texts and Monographs. Volume 8. New York: Interscience Publishers (1958)]. The parts covered by the synopsis include general laws of reflection and refraction at the interface between two media, spherically and axially symmetric optical systems, 3rd and 5th order image error theory, and the interpolation theory of optical systems. R.A.Newing

535.31

152 THE PROBLEM OF DEFINITION AND DEPTH OF FIELD IN PHOTOGRAPHIC LENSES WITH LONG FOCAL LENGTH AND USING AUXILIARY LENSES.
V.Rendondo Mena.
An. Real Soc. Espan. Fis. Quim., Vol. 55A, No. 5-6, 157-74 (May-June, 1959). In Spanish.

The Mollar lens can be used as an auxiliary lens to give increased depth of field to a photographic lens. It has zero power for a mean wavelength but introduces considerable chromatic aberration. Methods of computation are given and a theoretical account is given of the effective depth of field with such a lens. A means of computing the loss of resolution to be expected is also explained. Experimental results with typical lenses are shown. R.W.Fish

535.33

153 APPARATUS DRAWINGS PROJECT. REPORT NUMBER 1. BALMER SERIES SPECTRUM TUBE.
R.G.Marcley.
Amer. J. Phys., Vol. 28, No. 1, 35-8 (Jan., 1960).

The first of a series of articles containing construction notes and drawings of apparatus for teaching. A spectrum tube for the Balmer series of hydrogen that is simple to construct, reliable, and has a useful life in excess of 1500 hours is described. The intensity of the atomic spectrum of hydrogen is more than adequate for visual work with a grating replica or prism, and under proper conditions would be sufficient for photographic use. The molecular spectrum of hydrogen is of negligible intensity when the tube is properly filled. Full information is given on the construction and filling of the tube.

535.33

154 HISTORICAL SURVEY OF THE EARLY DEVELOPMENT OF THE INFRARED SPECTRAL REGION. E.S.Barr.
Amer. J. Phys., Vol. 28, No. 1, 42-54 (Jan., 1960).

This account of the early history of the infrared spectral region is concerned with tracing the growth in understanding of the nature and properties of this radiation from the time of its discovery by Herschel in 1800 up to the first part of the present century. After workers in the first half of the 19th century had demonstrated the fundamental similarity of infrared and visible radiation, investigators during the second half discovered the materials and evolved the techniques of measurement and control of infrared radiation which provide the foundation for the current extensive use of infrared equipment in research, industry, and ordnance.

535.33

155 FIVE-METER VACUUM SPECTROMETER FOR THE NEAR INFRARED. D.H.Rank, G.D.Saksena, G.Skorinko, D.P.Eastman, T.A.Wiggins and T.K.McCubbin,Jr.
J. Opt. Soc. Amer., Vol. 49, No. 12, 1217-22 (Dec., 1959).

A vacuum spectrometer capable of obtaining resolution approaching the maximum theoretical resolution of a 7 in. diffraction grating doubly passed has been constructed for use in the region of sensitivity of lead sulphide photoconductive cells. The design and construction of the instrument and its performance in the resolution of spectral details and the measurement of wavelengths are discussed.

535.33

156 AUTOMATIC SLIT DRIVE FOR INFRARED SPECTROMETERS. D.F.Eggers, Jr. and M.T.Emerson.
J. Opt. Soc. Amer., Vol. 50, No. 1, 11-13 (Jan., 1960).

An automatic slit drive has been constructed for a single-beam infrared spectrometer, using two helical potentiometers in a servosystem. The output of generator potentiometer is heavily loaded causing its output voltage function to curve sharply with displacement. This reduces the number of taps per prism to two. Evaluation of circuit parameters is described, and values are listed for prisms of calcium fluoride, sodium chloride, potassium bromide, and caesium bromide, used in double pass. A simple modification permits selection of several different energy levels. The resulting curves of spectrometer output versus frequency are constant.

535.33

157 SLAVE RECORDER FOR AN INFRARED SPECTROPHOTOMETER. C.A.Glass, L.R.Bair and E.H.Melvin.
Rev. sci. Instrum., Vol. 30, No. 9, 835-6 (Sept., 1959).

Describes an addition made to a Perkin–Elmer model 21 spectrophotometer to permit direct recording on to 5 in. × 8 in. filing cards. G.F.Lothian

535.33

158 BACKGROUND OF THERMAL RADIATION IN INFRARED SPECTROSCOPY.
B.I.Stepanov and Ya.S.Khvashchevskaya.
Optika i Spektrosk., Vol. 5, No. 4, 393-403 (1958). In Russian.

Formulae are obtained which allow for the effect of thermal emission of the radiation receiver and the cell containing the substance studied. This emission is called a "negative radiation flux", and it must be taken into account in any complete discussion of thermal radiation balance in infrared spectroscopy. Negative radiation fluxes are present also in scattering processes (scattering by $MnSO_4$ powder). In determination of the temperature dependence of the absorption coefficients even emission of the cell windows has to be allowed for. A.Tybulewicz

535.33

159 LARGE-APERTURE GRATING SPECTROGRAPH UTILIZING COMMERCIAL CAMERA COMPONENTS.
A.M.Bass and K.G.Kessler.
J. Opt. Soc. Amer., Vol. 49, No. 12, 1223-5 (Dec., 1959).

A compact, large-aperture spectrograph utilizing commercially available optical components has been designed and constructed. Light is admitted through an adjustable bilateral slit and is collimated by a 300 mm f/4.5 telephoto camera lens. The dispersive element is a 102 × 102 mm, 600-lines per mm plane reflection grating with a first-order blaze at 1.0 μ. The spectrum is photographed with a single-lens reflex 35 mm camera equipped with a 75 mm f/1.5 lens. One frame covers a spectral range of approximately 8000 A with a dispersion of about 200 A/mm in the first order.

535.33

160 COLLABORATIVE READINGS WITH THE CARY-14 SPECTROPHOTOMETER. J.M.Vandenbelt.
J. Opt. Soc. Amer., Vol. 50, No. 1, 24-7 (Jan., 1960).

Absorption readings of dichromate solution standards were made with 9 Cary-14 spectrophotometers and 16 Cary-11 spectrophotometers. Agreement among instruments was somewhat better than that obtained in previous similar studies with ultraviolet solution standards. The absorption spectra of two glass filters were determined in the near infrared region with the Cary-14 spectrophotometers. Wavelength and absorbance readings were in excellent agreement.

535.33

161 HYDROGEN AND MERCURY-HELIUM LAMPS FOR SF-4 SPECTROPHOTOMETERS.
S.I.Levikov and L.P.Shishatskaya.
Optika i Spektrosk., Vol. 6, No. 5, 688-91 (May, 1959). In Russian.

Describes construction, electrical, spectral and other properties of a low-voltage hydrogen (4 mm Hg) arc lamp VSFU-3 with a directly heated oxide cathode, and a mercury-helium (10-12 mm Hg of helium and a small amount of mercury) lamp RSFU-2 of similar construction. These lamps are normally used in conjunction with a quartz photoelectric spectrophotometer SF-4, but can be used also in other optical or spectral apparatus. The working life of either of these two lamps is not less than 200 hours.
A.Tybulewicz

535.33

162 THEORY OF GRATING SPECTROSCOPIC INSTRUMENTS WITH RECTANGULAR APERTURES.
K.D.Mielenz.
Optik, Vol. 16, No. 8, 458-99 (Aug., 1959). In German.

The author's theory of prism instruments (see, for example, Abstr. 10729 of 1959) is applied to grating instruments.

535.34

163 MEASUREMENT OF ABSORPTION, TRANSMISSION AND SCATTERING. I. GENERAL. G.Bauer.
Arch. tech. Messen, No. 279 (Ref. V. 462-3), 65-8 (April, 1959). In German.

A review of the definitions of the quantities used in these measurements and of Beer's and Lambert's laws. G.F.Lothian

535.39

164 PRECISION MEASUREMENT OF ABSOLUTE SPECULAR REFLECTANCE WITH MINIMIZED SYSTEMATIC ERRORS. H.E.Bennett and W.F.Koehler.
J. Opt. Soc. Amer., Vol. 50, No. 1, 1-6 (Jan., 1960).

Instruments for making precision measurements of the specular reflectance at essentially normal incidence in the near ultraviolet, visible, and infrared regions of the spectrum are described. The square of the absolute reflectance is measured, with a resultant increase in measuring precision, and the major sources of systematic error in making reflectance measurements have been reduced or eliminated. The difficulty in making precision reflectance measurements in the infrared, where integrating spheres cannot be used, has been overcome by a unique compensating feature in the infrared reflectometer which prevents the image on the detector from changing size or position because of a slight tilt of the sample. The measurements made with these instruments on high reflectance samples are believed to be good to ±0.001.

535.8

165 THE NEWTONIAN FLAT.
R.V.Willstrop.
Monthly Notes Astron. Soc. S.Africa, Vol. 28, No. 5, 54-5 (1959).

A detailed description of a method of cutting and polishing diagonal mirrors for a Newtonian telescope without the use of a lathe or a drilling machine. W.T.Welford

535.8

166 SOME ADVANTAGES OF THE APPLICATION OF A SPECIAL TYPE OF MOVING PRISM COMPENSATOR TO "MOVIOLAS". S.Guidarelli.
Atti Fond. Ronchi, Vol. 14, No. 4, 415-25 (July-Aug., 1959). In Italian.

The common form of moving prism compensator, used in a "moviola" to compensate for film movement, has been shown to introduce residual errors. A new type of system with rotating prisms is described in detail and its errors deduced. These are shown to be considerably less than those of the standard system.
R.W.Fish

535.8

167 PROCEDURE FOR EVALUATING THE SMALL OBJECT DETECTING CAPABILITY OF AN ELECTRON-SCANNED IMAGE TUBE. L.Glatt.
J. Opt. Soc. Amer., Vol. 49, No. 12, 1209-12 (Dec., 1959).

Image tube performance evaluation is usually presented in terms of scene resolution and contrast capabilities. The extension of these image concepts to small target detection configurations that occur in military applications is not immediately evident. The purpose of this paper is to: (a) propose criteria for evaluating the minimum detectable increments in radiant power arriving from small targets; and (b) described a laboratory test procedure for implementing the foregoing evaluation. The procedure is based on system response to a unit spatial-impulse input. The minimum detectable input power differences for a system utilizing a uniform film image tube as a sensor are a function of the angular extent of the target as measured from the optics. The minimum detectable increment in response density is considered to be a fundamental system parameter to be determined. The peak response density is related to the input density through a response-degradation curve. The method was developed for use with the Westinghouse Thermicon and is being applied to the evaluation of preliminary models of that infrared image tube. It is fully applicable, however, to any other uniform film image tube.

535.8

168 ON THE LIMITING SENSITIVITY OF THE STAR TEST FOR OPTICAL INSTRUMENTS. W.T.Welford.
J. Opt. Soc. Amer., Vol. 50, No. 1, 21-3 (Jan., 1960).

Calculations of the light flux distribution in the defocused star image suggest that $\lambda/60$ of sharply varying aberration and $\lambda/20$ of slowly varying aberration can be detected.

535.8

169 PHOTOGRAPHIC PHOTOMETRY OF A FLASH TUBE USING A HIGH-SPEED STREAK CAMERA.
G.G.Milne and N.D.Miller.
J. Opt. Soc. Amer., Vol. 49, No. 12, 1213-17 (Dec., 1959).

The General Radio Strobolux unit triggered by a Strobotac has been used extensively in the authors' laboratory for visual threshold determinations. This photometric study was undertaken to provide information on the duration of the flash and the constancy of the total energy for successive flashes. By using a standardized ribbon filament lamp for a comparison source and four narrow-pass filters, the total energy per flash in absolute units was found for four spectral regions. A high-speed camera developed by O'Brien was used for the photographic record. A narrow slit illuminated by the Strobolux was imaged on a strip of 16 mm Super-XX film carried on the inner circumference of a drum mounted on the shaft of a vertical motor. When the drum was driven at 10 800 rev/min the exposure time on the film was 0.236 μsec. The film was calibrated by exposing a standard lamp through a stepped slit on the same record. The peak luminance through a 550 mμ interference filter is 7660 c/cm^2 of tube area. The duration of the flash is about 100 μsec with 90% of the energy delivered in 41 μsec.

535.8 : 534.39

SPECTROPHONE WITH A MULTIPLE PASSAGE OF RADIATION. See Abstr. 137

535.8

170 HIGH-INTENSITY PULSED LIGHT SOURCES.
M.P.Vanyukov and A.A.Mak.
Uspekhi fiz. Nauk, Vol. 66, No. 2, 301-29 (Oct., 1958). In Russian.
English translation in Soviet Physics—Uspekhi (New York), Vol. 66(1), No. 1, 137-55 (Sept.-Oct., 1958).

The light sources reviewed are sparks, capillary sparks, surface discharges, exploding wires and shock waves. Measurements of temperature and brightness at time resolutions down to 10^{-8} seconds are described. Conditions for attaining black-body radiation are examined and it is suggested that a maximum brightness is reached as power input is increased. 100 references.
E.R.Wooding

535.8 : 551.5

171 A SEARCHLIGHT WITH A 2-KW HIGH PRESSURE MERCURY VAPOUR LAMP FOR ATMOSPHERIC SCATTER AND EXTINCTION MEASUREMENTS.
C.Junge, G.Löwe, K.Rademacher, R.Rompe and O.Singer.
Exper. Tech. der Phys., Vol. 7, No. 3, 139-42 (1959). In German.

Description of specially designed projection apparatus with luminous energy distribution giving a high light-flux (about 50% total) in u.v. and green Hg lines. The average light-flux is ~45 000 candles/cm^2. Selective filters are used to isolate the lines at 3650 and 5790 A, as required. Means are also provided to ensure precise focusing, and orientation of the collimated beam used for projection photometry. D.R.Barber

PHYSICAL OPTICS

(Luminescence is included under Solid-State Physics, Liquid State, or Gaseous State)

535.41 : 531.71

MICRO-INTERFERENCE AS AN AID TO TESTING THE SHAPE OF ASPHERICAL SURFACES. See Abstr.60

535.41

172 NOTES ON AN INEXPENSIVE FORM OF MICHELSON'S INTERFEROMETER. T.G.Bullen.
Amer. J. Phys., Vol. 27, No. 7, 520-1 (Oct., 1959).

Describes modifications to a simple form of Michelson's interferometer which enables greater accuracy to be attained because of easier working conditions. A cell for the determination of the refractive index of gases is described. E.G.Knowles

535.41

173 SOME MORE ASPECTS OF THE MICHELSON INTERFEROMETER WITH CUBE CORNERS.
M.V.R.K.Murty.
J. Opt. Soc. Amer., Vol. 50, No. 1, 7-10 (Jan., 1960).

In the application of the Michelson interferometer for measurement of length by photoelectric methods there is a choice of either plane mirrors or cube-corners as the end reflectors. In the present paper it is shown that the guide on which the moving cube-corner moves needs to be only of moderate accuracy whereas it is known that the guide must be made very accurately when plane mirrors are used.

535.41

174 DOUBLE SLIT INTERFERENCE. E.L.Cleveland.
Amer. J. Phys., Vol. 27, No. 7, 521-2 (Oct., 1959).

Describes the use of two sets of concentric semicircles on photographic film, together with a protractor (also on film) to illustrate the fundamental properties of double-slit interference. E.G.Knowles

535.41

175 CHARACTERISTICS OF THE PHASE-DISPERSION INTERFERENCE FILTER.
P.W.Baumeister, F.A.Jenkins and M.A.Jeppesen.
J. Opt. Soc. Amer., Vol. 49, No. 12, 1188-90 (Dec., 1959).

A filter in which the two high-reflection elements are dielectric multilayers of the type that show a rapid wavelength variation of the phase change on reflection yields several pass bands, some of which are very narrow. The grouping of these bands, and their various widths, depend in a characteristic way on the order in which the individual layers of the multilayers are arranged on the two sides of the spacer. Fair quantitative agreement is obtained between the theoretical and observed positions and widths of the bands. For an asymmetrical arrangement of the layers the filter shows, at one particular wavelength, no splitting of the pass band into polarized components at non-normal incidence.

535.42 : 534.41

LIGHT DIFFRACTION ON HARMONICS OF DISTORTED ULTRASONIC WAVE. See Abstr. 140

535.42

176 PREPARATION OF PHASE DIFFRACTION GRATINGS BY VACUUM EVAPORATION. A.E.Ennos.
J. Opt. Soc. Amer., Vol. 50, No. 1, 14-17 (Jan., 1960).

Methods for preparing laminar phase diffraction gratings of up to 400 lines per in. are described. The grating is copied photomechanically from a master amplitude grating and the phase-reversing layer applied by vacuum evaporation. Silica is used for transmission and chromium for reflection gratings, the resultant optical elements being extremely robust and of a high degree of uniformity.

535.5

177 ON THE DETERMINATION OF THE DEGREE OF POLARIZATION OF LIGHT BY MEANS OF THE PHOTOELECTRIC COMPENSATION METHOD. A.Kawski and A.Skwierz.
Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 7, No. 6, 361-4 (1959).

Gives formulae for the intensities of both polarizations transmitted by a pile of any given number of plates, taking account of absorption and multiple reflections. W.T.Welford

535.51 : 539.23

178 A POLARIZATION EFFECT IN [VACUUM] EVAPORATED ALUMINIUM FILMS IN THE CASE OF NORMAL [UNPOLARIZED] LIGHT INCIDENCE. G.Thiessen and P.Broglia.
Z. Astrophys., Vol. 48, No. 2, 81-7 (1959). In German.

Aluminium mirrors may produce polarization up to 10% in the reflected light. This effect can be avoided if the glow discharge for final cleaning of the mirror face is everywhere normal to the mirror face, so that the electrical field component lying in the mirror face is zero and the direction of incidence of the charged particles is perpendicular to the mirror. This can be managed by using a complete disk as the cleaning electrode, with a diameter ≥ the diameter of the mirror.

535.52

179 OPTICS OF ABSORBING CRYSTALS. III. CRYSTALS OF LOWER SYMMETRY. THE OPTIC AXES.
F.I.Fedorov.
Optika i Spektrosk., Vol. 5, No. 3, 322-33 (Sept., 1958). In Russian. English summary: PB 141047T-7, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

For Pt II, see Abstr. 933 (1958). Entirely theoretical treatment of the optics of absorbing biaxial crystals. General expressions are obtained for polarization of plane waves and for the directions of the optic axes. 19 references. W.T.Welford

535.56

180 AN INFRA-RED POLARISCOPE. A. Besse and F. Desvignes.
Rev. Opt., Vol. 38, No. 7, 344-8 (July, 1959). In French.

The polariser and analyser were silicon mirrors at the Brewster angle (74°). A filament lamp was used with glass collimating and imaging optics and either an i.r. image convertor or an i.r. vidicon as detector. Single crystals of germanium and silicon intended for use in semiconductor devices were examined and the short wavelength transmission limits of these together with the long wavelength sensitivity limits of the detectors gave a narrow band-width in the 1-2μ region. A sensitivity of 4° of phase is claimed. W. T. Welford

COLORIMETRY . PHOTOGRAPHY

535.6

181 GLASS COLOR STANDARDS AND A UNIFORM CHROMATICITY SCALE FOR SUGAR PRODUCTS. B.A.Brice.
J. Opt. Soc. Amer., Vol. 50, No. 1, 49-56 (Jan., 1960).

Colour specifications for the official glass colour standards of the U.S. Department of Agriculture for extracted honey, maple syrup, sugarcane syrup, and sugarcane molasses are presented. These standards are used for rapid classification of samples according to chromaticity. The chromaticities of the standards are widely and irrgularly spaced along the sugar products locus on the C.I.E. chromaticity diagram. Continuous single-number scales for colour used in the sugar industry are based either on absorption measurements at specified wavelengths or on small-difference colorimetry. The uniform colour scale of "N.B.S. units of sugar colour", proposed by Deitz and based on the Adams colour-difference formula, is useful as presently formulated only for the lighter colours. In the present paper a greatly extended scale of uniform chromaticity, based on MacAdam's data, is presented for application to solutions of sugar products. Loci of points on the C.I.E. diagram differing from the achromatic point by 5, 10, 15 ..., 220 units of chromaticity difference are established, and their intersections with an average locus of sugar products are determined Forty-five glass colour standards having chromaticities close to these intersections and thus spaced 5 units apart on the scale are described. The number of MacAdam units of sugar chromaticity, ΔS, for a given sample can be estimated by three methods; by interpolation between the aforementioned loci

on the C.I.E. diagram, if the chromaticity coordinates of the sample are known; by visual comparison with the 45 glass standards of known ΔS; and by measuring absorbancy of the sample at 420, 560, or 720 mμ and referring to graphs relating absorbancy to ΔS, if turbidity is negligible.

535.6

182 LIGHT SOURCES AND COLOR RENDERING. D.Nickerson.

J. Opt. Soc. Amer., Vol. 50, No. 1, 57-69 (Jan., 1960).

Light sources for many problems in agriculture and industry require good colour rendering; standards are needed for both special and general purpose lamps. Target standards are discussed, and colour, relative spectral distributions, and lumen efficiency data are provided for typical incandescent and fluorescent lamps. Data for colour samples calculated for triads of light sources studied by an I.E.S. Subcommittee on Color Rendition of Light Sources are used to demonstrate the comparative size and direction of colour differences involved in common situations. Problems raised by chromatic adaptation are discussed, as are specifications and standards for sources used for colour work in various specialized industries, and the progress being made by I.E.S. and C.I.E. committees on colour rendering.

535.6

183 FORMULATION OF TRANSPARENT COLORS WITH A DIGITAL COMPUTER. F.W.Billmeyer, Jr, J.K.Beasley and J.A.Sheldon.

J. Opt. Soc. Amer., Vol. 50, No. 1, 70-2 (Jan., 1960).

A digital computer was programmed to calculate the concentrations required to produce a given transparent colour by mixing soluble dyes. The computation is based on Beer's law calculations at 65 wavelengths across the visible spectrum. The colour to be formulated is specified in terms of C.I.E. tristimulus values derived from instrumental measurement. The computer formulation technique was tested by making up to computed formulae a series of mixtures of dyes in a solvent and in acrylic resin. The correspondence was good between the measured colours of the mixtures and those for which the formulations were calculated, as indicated by colour differences averaging about 1 N.B.S. unit (Adams chromatic value formula, normalized as in A.S.T.M. Method D 1482-57T).

535.6

184 MEMORY COLORS OF FAMILIAR OBJECTS. C.J.Bartleson.

J. Opt. Soc. Amer., Vol. 50, No. 1, 73-7 (Jan., 1960).

The memory colours of ten familiar, naturally occurring objects were determined. Fifty observers chose their memory colours from an array of 931 Munsell colour chips. The variability of the judgments is shown and their means are compared with the average chromaticities of the corresponding natural objects. The ten mean memory colours were all significantly different from the natural colours. Each memory colour tended to be more characteristic of the dominant chromatic attribute of the object in question; grass was more green, bricks more red, etc. In most cases, saturation and lightness increased in memory.

535.65

185 SMALL-FIELD CHROMATICITY DISCRIMINATION. D.L.MacAdam.

J. Opt. Soc. Amer., Vol. 49, No. 12, 1143-6 (Dec., 1959).

The evaluation of the noticeability of chromaticity differences between very small areas is needed in studies of colour graininess. In the present work, color-discrimination data for eleven well-selected chromaticities were determined by a single observer using a matching method for fields subtending (a) 3' and (b) 4.4°. The data for the large field agree fairly well with those previously published. The comparable results for the 3' field have been summarized for convenience in the form of a plane uniform chromaticity diagram in which the standard C.I.E. coordinate network is curvilinear. The diagram represents a simplified approximation to the actual results, which would require a curved surface for accurate representation. Nevertheless, the present diagram is suitable for evaluating the large chromaticity differences that are encountered in colour graininess and in most other applications of small-field colour-discrimination data.

535.65

186 MEASUREMENT OF COLOR RENDERING TOLERANCES. B.H.Crawford.

J. Opt. Soc. Amer., Vol. 49, No. 12, 1147-56 (Dec., 1959).

The colour rendering tolerances in different bands of the spectrum of an illuminant have been measured by direct experiment using several levels of illumination and a variety of test objects, including pictures, foodstuffs, and the human complexion. The spectral bands were contiguous, covering the whole visible spectrum, and their widths were chosen so that they had approximately equal weight from a colour rendering point of view. All tolerances were measured in relation to a full radiator reference illuminant, for single bands and also for combinations of bands. With these results it is possible to predict the colour rendering performance of an illuminant knowing only the relative energy distribution in its spectrum. Examples are given. In general, the computed performance agrees with practical judgments derived from ordinary use.

535.65

187 BLUE END OF THE SPECTRUM LOCUS ON A COLOR MIXTURE DIAGRAM. G.A.Fry.

J. Opt. Soc. Amer., Vol. 49, No. 12, 1156-8 (Dec., 1959).

The blue corner of the author's (1948) colour mixture diagram is dichromatic in the sense that all colours in this region can be matched by mixtures of 465 mμ and a monochromatic stimulus at the red end of the spectrum. In order to locate spectrally pure stimuli below 486.8 mμ on the mixture diagram it has been necessary to use 486.8 mμ, 520 mμ and 674 mμ as primaries. One can also use the fact that the confusion lines are straight and converge at the alychne to increase the precision in plotting. The author's own mixture data are used to illustrate these principles.

535.65

188 NEW PIGMENT-MIXTURE DIAGRAM AND COLOR SYSTEM. E.Friel.

J. Opt. Soc. Amer., Vol. 49, No. 12, 1159-68 (Dec., 1959).

This paper deals with processes which operate when pigments are combined. Usually it is assumed that one may learn of these processes only by trial and error and that information acquired in this way cannot be imparted to others. From experience as a painter and decorator the author believes otherwise; that is, that these processes are simple enough so that, given a proper method, useful information about them could be organized and presented in a form understandable to any interested person. With this in mind a simple diagram was devised to show general mixture-relationships among red, yellow, and blue pigments and their combinations. Though this was useful to a degree, its limitations were evident, since it did not deal concretely with most pigments in common use. By trial and error, points indicating a selection of pigments were incorporated into the diagram, with the objective that colour-mixture relationships among the pigments should be expressed in terms of linear relationships among the points. The advantages of such an arrangement were at one apparent. Using this as a point of departure and drawing from the experience of people inquiring into similar processes operating when coloured lights are combined, a new colour system was built, consisting of devices and conventions designed to supplement and facilitate use of information so presented. To what degree the pigment positions had been so arranged as to secure the nearest-possible approach to linear colour-mixture relations remained for a time unknown. Meanwhile doubt was expressed that it is possible to arrange them so as to provide useful approximations of the relationships involved. Then a new experimental technique was devised. This led to correction of errors in locating the pigment positions and produced evidence that information about colour-mixture relationships among pigments can be summarized very well in diagramatic form. Some features of the colour system mentioned are noted. The experiments are described and data presented for review.

77

189 IMPROVEMENT IN SPARK SHADOWGRAPH TECHNIQUE. J.C.Muirhead and F.L.McCallum.

Rev. sci. Instrum., Vol. 30, No. 9, 830-1 (Sept., 1959).

Shadowgrams obtained on Polaroid film are examined immediately after each experiment. A beam-splitting mirror conveys the image to two cameras, one being loaded with conventional film for subsequent reproduction and the other being loaded with Polaroid film. E.R.Wooding

77

190 THE PROPERTIES AND USE OF DILUTED NUCLEAR EMULSIONS. G.Philbert and M.Meschonnie.

"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 401-8. In French.

The characteristics of diluted emulsions are given. Their

behaviour during processing is studied and a standardized procedure is suggested. It is found that the methods in use for the determination of the nature and charge of particles in normal emulsions are applicable to a good approximation. S.J.St-Lorant

77

191 THE VARIATION OF THE BACKGROUND FOG IN NUCLEAR EMULSIONS WITH THE pH OF COLD DEVELOPER. J.Bermond and M.Schèrer.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 375-83. In French.

The influence of the pH of an amidol developer on the density of background fog at different depths in 400 μm Ilford G5 emulsion is studied. The pellicles are treated in developer at 5°C for 80, 90, 100 and 120 min. The results are discussed in terms of the blocking effect of the pH of the emulsion relative to the pH of the developer. S.J.St-Lorant

77

192 TANNING DEVELOPMENT OF NUCLEAR EMULSIONS. J.Kubal.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 255-7. In French.

Describes the reduction of distortion obtained by this method. S.J.St-Lorant

77

193 THE PROBLEM OF PROCESSING A GIVEN VOLUME OF EMULSION. G.Marguin.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 279-89. In French.

It is proposed to employ unbacked emulsion pellicles 1 mm thick, held in Perspex supports, and stacked with their supports during the exposure. During processing the supports carrying the emulsion are locked into stainless steel racks to prevent distortion. The developer is intended to act from both sides of the pellicle. Development takes place at one low temperature and is based on the progressive changes of the pH of the solutions. The method claims to give uniform development throughout the volume of the emulsion with minimum distortion, and with unchanged physical dimensions of the pellicles. S.J.St-Lorant

77

194 A METHOD OF AVOIDING CORROSION DURING FIXING. M.Paic, G.Thuro and M.Turk-Zivkovic.
"Particle photography" conference, Strasburg, 1957 (see Abstr. 11704 of 1959) pp. 259-72. In French.

It is shown that the dissolution of silver in emulsion by fixing solutions is greatly enhanced by the presence of dissolved atmospheric oxygen. The reduction in corrosion obtained with deoxygenated water is noted, and the inhibitive action of sodium sulphite and bisulphite studied. A table summarises the effect of the various parameters on grain corrosion. S.J.St-Lorant

77

195 THE RANGE–ENERGY RELATION IN NUCLEAR EMULSIONS. W.H.Barkas.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 291-3. In French.

Gives a table of the equivalent proton range–energy relation in nuclear emulsion of standard density (ρ = 3.815 g/cm^3) between 1 and 700 MeV. For detailed work see Abstr. 4203-4 of 1958. S.J.St-Lorant

77

196 ON THE GRAIN DENSITY OF TRACKS IN NUCLEAR EMULSIONS. J.P.Bailliard.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 333-44. In French.

Re-examines the efforts made to date to explain the formation of tracks by the passage of charged particles through nuclear emulsions. The recent developments in the theory of the latent image formation receive considerable attention; a general model of granulation closely connected with image formation is proposed which aims to take into account some of the principal aspects associated with grain formation. Included in the treatment are the grain densities of protons and α-particles at minimum ionization, the existence of a saturation limit, the fluctuations of grains according to the Poisson distribution law, and the high sensitivity of some available emulsions. S.J.St-Lorant

77

197 IDENTIFICATION OF PARTICLES IN FINE-GRAIN EMULSIONS. I.Ahmad, P.Demers and J.L.Meunier.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 305-28. In French.

The information which can be obtained from the analysis of the structure of a track in emulsion is reviewed. The authors discuss the accuracy of the conclusions which may be drawn from measurements made in specially prepared fine-grain emulsion with emphasis on counting methods. It is claimed that in the emulsion used it is possible to estimate ionization in the range from 1 to 34 times minimum, and in particular that it is possible to identify particles of unit charge by the total grain count alone. The residual range required to separate particles of different mass and change by gap count or integral gap length is reduced by a factor of ~ 2 in such an emulsion. Multiple scattering measurements are discussed in so far as the relation between grain size and background noise is concerned. Photometric methods of identification are mentioned. S.J.St-Lorant

77

198 MIXTURES OF NUCLEAR EMULSIONS. M.Rene and G.Vanderhaeghe.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 345-8. In French.

Describes without details the use and the properties of emulsions compounded from gels of different sensitivity. S.J.St-Lorant

77

199 PHOTOMETRIC ANALYSIS OF TRACKS IN NUCLEAR EMULSIONS FROM THE POINT OF VIEW OF DISCRIMINATION. P.G.Bizzeti and M.Della Corte.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 349-55. In French.

A photometric device is described which facilitates the measurement of the width of tracks in nuclear emulsions. The use of suitable parameters is discussed and the effect of dip on the track profile evaluated with the help of a simple model. C^{12} tracks are used to compare different methods and to show the good agreement with other published work. S.J.St-Lorant

77

200 IDENTIFICATION OF TRACKS BY MEASUREMENT OF THEIR WIDTH. J.P.Lonchamp and C.Gegauff.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 297-303. In French.

Reviews briefly the attempts made to explain the process of slowing down of particles of $Z \geq 2$, and the corresponding effect on the width of the track. Some results on the mean track widths of C^{12} ions are presented and the fluctuations in width as a function of the residual range discussed. A comparison between the profiles of H^2 and He^3 tracks is made and it is shown that no clear separation of charges is possible with present methods. S.J.St-Lorant

77

201 THE PRECISION OF ANGULAR MEASUREMENTS IN NUCLEAR EMULSIONS. W.M.Gibson and J.G.McEwen.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 371-3. In French.

Discusses the factors limiting the accuracy with which relative directions of different tracks can be measured, in particular the effect of non-uniform shrinkage of the emulsion. S.J.St-Lorant

77

202 DISCRIMINATION BETWEEN PARTICLES AT HIGH γ-INTENSITIES BY MEANS OF A POTASSIUM FERRO-OXALATE DEVELOPER. H.Braun.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 329-32. In French.

Gives the composition of a relatively stable developer capable of rendering α-particle and proton tracks visible in Ilford C-2 and E-1 emulsion under conditions of extreme background. A method of measuring the reduction potential and ensuring reproducibility of development is described, and modifications to suit prevailing conditions suggested. S.J.St-Lorant

77 : 535.24

THE IMPORTANCE OF GRAIN SIZE IN PHOTOGRAPHIC MICROPHOTOMETRY. See Abstr. 150

HEAT . RADIATION

536.24 : 533.6

203 ON SOME PROBLEMS OF HEAT TRANSFER IN FREE MOLECULE FLOW.

I.Zv.Krzywoblocki and F.H.Bergonz.

cta phys. Austriaca, Vol. 12, No. 4, 400-11 (1959).

Presents briefly the general theory for aerodynamic heating free molecule flow. This is applied to a cone and a paraboloid revolution in an attempt to predict surface temperatures. Only e aerodynamic effects are considered, i.e. the entire heat trans- r to the body is made by the energy exchange of the gas mole- ules only. No effect of radiation to or from the body is considered.

536.25 : 534.39

ACOUSTIC STREAMING EFFECTS ON CONVECTIVE HEAT RANSFER. See Abstr. 138

536.3

204 A REPRODUCIBLE 4000°K BLACK RADIATOR.

F.Anacker and R.Mannkopff.

.Phys., Vol. 155, No. 1, 1-15 (1959). In German.

A detailed description is given of the radiator and associated ectrophotometric recording equipment used for testing the diator, which consists of an electrically heated horizontal carbon be with water cooled copper ends. The radiation from a short × 10 mm) slit in the middle of the tube and parallel to its axis focussed on to the entrance slit of a spectrograph and the time riation of the spectrum within the region 4820 ± 20 A is photo- aphed on a moving photographic plate. An external gas flame rected against the radiator slit prevents disturbances due to ndensing carbon and the results show that the sublimation temper- ure (4000 ± 7°K) of carbon can be reproduced easily and accur- ely. S.Weintroub

536.3

205 MEMORANDUM ON A PROCEDURE FOR OBTAINING SPECTRAL RADIANT INTENSITIES OF TUNGSTEN-FILAMENT LAMPS, 400-700 mμ. L.E.Barbrow.

. Opt. Soc. Amer., Vol. 49, No. 11, 1122 (Nov., 1959).

Gives a short calculation to illustrate method, together with a able of radiant intensities in micro-watts per steradian per 10 mμ r black-bodies of temperature 2300°(100°) 2800°K and 2854°K, for ae wavelength range 400(10)700 mμ. P.A.Young

536.33

206 THE RECORDING OF THE FINE-STRUCTURE OF THE HEAT RADIATION OF HUMAN BODIES.

.Kroebel and K.Vanselow.

. angew. Phys., Vol. 11, No. 1, 19-27 (Jan., 1959). In German.

The intensity distribution of the heat radiation from the human dy shows a characteristic fine structure the changes in which oduced by illness can be used for diagnostic purposes. It corres- nds to a black body of 0.01° to 1°C, and extends over large areas the human body the temperature of which may vary between 15 nd 35°C. An electronic scanning apparatus consisting of a cooled bS photocell, special amplifier, and recorder, is described in tail. The fine structure distribution could be obtained in some ten inutes with a sensitivity corresponding to about ±0.03°C. The sponse time of the recorder was 0.02 seconds. It is shown that an nproved sensitivity of up to ±0.01°C could be obtained if the fre- uency of the radiation chopper used was raised to 50 c/s.

S.Weintroub

536.41

207 DILATOMETERS FOR HIGHLY VISCOUS SYSTEMS: RECORDING AND NON-RECORDING INSTRUMENTS.

F.Voeks and R.A.Crane.

nalyt. Chem., Vol. 31, No. 11, 1906-8 (Nov., 1959).

Describes the construction of a dilatometer suitable for studies n chemically reactive highly viscous liquids (polymerizing mixtures). he reactive liquid is kept separate from the indicating liquid of low scosity by a barrel-piston system. Conversion to a recording latometer is described. E.G.Knowles

536.42

208 REDUCTION OF STEFAN'S PROBLEM TO A SYSTEM OF ORDINARY DIFFERENTIAL EQUATIONS.

.G.Melamed.

Izv. Akad. Nauk SSSR, Ser. geofiz., 1958, No. 7, 848-69. In Russian. English summary: PB 141042T-3, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

The temperature distributions in the solid and liquid phases, when the interface is moving, are expressed as Fourier series, whose coefficients satisfy certain ordinary differential equations. The properties of these equations and their solutions are discussed carefully, and a numerical application to the thawing of a frozen soil is described. J.Hawgood

536.42 : 537.52

209 OBSERVATIONS ON ELECTRIC-WIRE EXPLOSIONS.

W.Schaaffs.

Z. angew. Phys., Vol. 11, No. 2, 63-5 (Feb., 1959). In German.

An X-ray study has been made and it is concluded that particles leave the wire with velocities of more than 1000 m/sec. J.M.Hough

536.46

210 THEORY OF FLAMES PRODUCED BY UNIMOLECULAR REACTIONS. I. ACCURATE NUMERICAL SOLUTIONS.

J.O.Hirschfelder and A.McCone, Jr.

Phys. of Fluids, Vol. 2, No. 5, 551-64 (Sept.-Oct., 1959).

The time dependent flame equations are presented in complete generality, including the effects of thermal diffusion, radiation, external forces, and pressure variations. The one-dimensional steady-state laminar flame supported by the unimolecular reaction A → B is studied carefully with special emphasis on the effects of heat transfer to the flame-holder. It is found that in agreement with Spalding's work on a somewhat different model there is a maximum amount of heat transfer which permits a steady state. For heat transfers less than this maximum there are two possible solutions of the flame velocity. The smaller of these flame velocities corresponds to an unstable mode. At exceedingly low pressures the flame velocity becomes comparable to the velocity of sound.

536.46

211 THEORY OF FLAMES PRODUCED BY UNIMOLECULAR REACTIONS. II. IGNITION TEMPERATURE AND OTHER TYPES OF APPROXIMATIONS. J.O.Hirschfelder.

Phys. of Fluids, Vol. 2, No. 5, 565-74 (Sept.-Oct., 1959).

An ignition temperature approximation is used to explain many of the properties of flames, including the effect of heat transfer to the flame-holder. The Corner, Adams, Wilde, and Klein [Abstr. 6959 of 1949; 585 of 1955; 6114 of 1957 and University of Wisconsin Naval Research Laboratory Report CF-957 [(April, 1948), Part V] treatments are explained. Finally, a new approximation scheme (based on the Adams and Wilde) is developed which is extremely accurate.

536.46 : 537.56

212 COMPARISON OF IONIZATION AND ELECTRONIC EXCITATION IN FLAMES. I.R.King.

J. chem. Phys., Vol. 31, No. 3, 855 (Sept., 1959).

Using a Langmuir probe, estimates have been made of ioniza tion in various flames, and these are compared with Wolfhard and Parker's observations on abnormal electronic excitation. For flames with air, agreement is good, but with some other flames there are differences. Hydrocarbon–NO flames show high ioniza- tion but thermal electronic excitation, while NH_3–NO has low ioniza- tion but moderately high excitation. A.G.Gaydon

536.53

213 ON THE USE OF PLATINUM RESISTANCE THERMOMETERS BETWEEN 90 AND 4°K. H. van Dijk.

Bull. Inst. Internat. Froid, Annexe 1958-1, 103-5.

Discusses the use of these thermometers for the region 4-10°K and 10-90°K. Corrections to obtain an accuracy of 0.1°K between 10 and 90°K are proposed. E.G.Knowles

536.53

214 A TEMPERATURE SCALE DOWN TO 20°K USING PLATINUM RESISTANCE THERMOMETERS

G.C.Lowenthal, W.R.G.Kemp and A.F.A.Harper.

Bull. Inst. Internat. Froid, Annexe 1958-1, 107-16.

Results are given of inter-comparisons of different platinum resistance thermometers in the temperature range from 90 to 20°K. Provided $\alpha > 0.003920$ and $\omega_{20^0k}/\omega_{90^0k}$ ($\omega_{20^0k} = R_{20^0k}/R_{273^0k}$) is within certain limits, accuracies to a few millidegrees are possible. On the basis of these results the platinum resistance thermometer is suggested as the means of extending the International Temperature Scale to this temperature region. E.G.Knowles

536.53

215 A PRACTICAL INTERPOLATION PROCEDURE FOR CARBON THERMOMETRY BETWEEN 1.5°K AND 30°K. A.R. de Vroomen.
Bull. Inst. Internat. Froid, Annexe 1958-1, 137-43.

Proposes an "interpolation" technique when several carbon resistance thermometers have to be used in an investigation. E.G.Knowles

536.55

216 TEMPERATURE MEASUREMENTS WITH AN ACOUSTICAL THERMOMETER.
A.van Itterbeek, G.Forrez, C.G.Sluijter and G.Vaes.
Bull. Inst. Internat. Froid, Annexe 1958-1, 155-64.

The velocity of sound in nitrogen, hydrogen and oxygen gases, at the boiling points (under about one atmosphere pressure) of their respective liquids, were measured for various pressures up to about 600 mm Hg. The results are reported. An attempt is made to deduce the temperature from the velocity values found by extrapolation of the measured values to zero pressure. With hydrogen, it is shown that there is agreement with the known temperature to within a few hundredths of a degree; the other cases are less successful. The limitations of accuracy are felt to be partly due to the technique used in finding the resonance of the gas column, from which resonance frequency the velocity is deduced; it is hoped to improve this technique. L.Mackinnon

536.55

217 MEASUREMENT OF FLAME TEMPERATURES BY THE METHOD OF RELATIVE INTENSITIES OF SPECTRAL LINES. A.P.Dronov, A.G.Sviridov and N.N.Sobolev.
Optika i Spektrosk., Vol. 5, No. 5, 490-9 (1958). In Russian.

Preliminary experiments showed that in acetylene–air and hydrogen–oxygen flames the following lines can be used for measurement of flame temperature: Li at 8126, 6104, 4972, 4603, 4132 A, and Na at 8195-83, 5688-83, 5154-49, 4983-79, 4669-65 A. The transition probabilities for these lines were determined by finding their relative intensities in acetylene–air and hydrogen–oxygen flames and measuring the flame temperature by the method using reversal of other Na and Li spectra lines. The mean experimental values of the transition probabilities of the five Na and five Li lines listed above agreed satisfactorily with the calculated results of Prokofiew (1929), Bates and Damgaard (1949) and Anderson et al (1956). A.Tybulewicz

536.58 : 533.5

218 METHOD TO PERMIT ACCELERATED WARM-UP OF THE OIL DIFFUSION PUMP OF THE ELECTRON MICROSCOPE WITHOUT OVERHEATING. F.W.Bishop.
Rev. sci. Instrum., Vol.30, No.9, 830 (Sept., 1959).

A bimetallic element (usually a standard feature of a diffusion pump) is arranged to insert a suitable resistance in series with the main heater when the oil approaches the operating temperature. This avoids any design compromise between rapid warm up and moderate working temperature for the oil. A.E.I. Research Laboratory

536.63

219 QUANTUM THEORY AND SPECIFIC HEATS. E.M.Loebl.
Amer. J. Phys., Vol. 27, No. 7, 519-20 (Oct., 1959).

Interprets in a simple qualitative manner the variations of specific heats observed at low temperatures. General quantum mechanical considerations only are introduced. E.G.Knowles

THERMODYNAMICS

536.7

220 PHASE COEXISTENCE AND HYSTERESIS. E.B.Smith.
J. Phys. Chem. Solids, Vol. 9, No. 2, 182-3 (Feb., 1959).

The strain terms arising from the coexistence of two phases are considered as perturbations to the bulk free energies, and a Clausius–Clapeyron type equation is derived as a relation between the temperature and pressure hysteresis. Values of the pressure hysteresis are calculated for a number of ammonium salts. M.G.Priestley

536.7 : 532.5

221 CHANGE OF TOTAL ENTHALPY IN LAMINAR MOTION. J.Passelecq.
Bull. Inst. Internat. Froid, Annexe 1958-1, 267-70. In French.

A calculation is given of the change of a fluid's total enthalpy due to heat conduction and viscosity in a given laminar flow. The increase is generally calculated in a laminar boundary layer and one may propound numerous simplifying hypotheses, taking into account the form of flow. It is then found that the increase of total enthalpy results from the temperature gradient and the kinetic energy gradient. On the other hand, in the general case, some new terms (apart from those gradients) are obtained, which show the effect of the curvature of streamlines and of variations in velocity, temperature and specific volume in the direction of flow. These terms, however, become negligible in slightly curved stream tubes if, moreover, the variations of the properties in the direction of the velocity are slow or if the volume considered is a very narrow stream tube. There remain the terms with a temperature gradient and a kinetic energy gradient, which are reduced to a gradient of total enthalpy if the Prandtl number is equal to unity.

LOW-TEMPERATURE PHYSICS

536.48

222 BOUND PAIRS IN FERMI FLUIDS. W.Brenig.
Z. Phys., Vol. 156, No. 3, 525-33 (1959). In German.

The effect of a hard core on the energy of bound pair states is considered. It turns out that such bound pairs can exist in nuclear matter for the real nuclear forces, but not in (non superfluid) He^3. The importance of this fact for a possible understanding of superfluidity is discussed briefly.

536.48

223 LOW-TEMPERATURE SPECIFIC HEAT OF LIQUID He^3 NEAR THE SATURATED VAPOR PRESSURE AND AT HIGHER PRESSURES.
D.F.Brewer, J.G.Daunt, and A.K.Sreedhar.
Phys. Rev. Vol. 115, No. 4, 836-42 (Aug. 15, 1959).

The specific heat of liquid He^3 was measured near the saturation vapour pressure in the range 0.085 to 0.75°K, and at pressures up to the melting pressure between 0.12 and 0.6°K. There is no evidence of a specific heat transition in the range of measurements. Near 0.1°K the specific heat near the saturated vapour pressure appears to tend linearly to zero at 0°K with a slope of 4.0±0.1 cal/mole-deg^2, providing evidence for regarding He^3 as a Fermi liquid near this temperature with an effective excitation mass of (2.00±0.05) × the mass of a He^3 atom. Entropies calculated with this linear extrapolation and with the assumption that no transition occurs below 0.085°K agree well with previous evaluations. Measurements at higher pressures show a negative dependence of specific heat on pressure above 0.16°K, but a positive dependence below this temperature, in contradistinction to the case of an ideal Fermi gas. (See also following abstract).

536.48

224 EXPANSION COEFFICIENT AND ENTROPY OF LIQUID He^3 UNDER PRESSURE BELOW 1°K.
D.F.Brewer and J.G.Daunt.
Phys. Rev., Vol. 115, No. 4, 843-9 (Aug. 15, 1959).

Measurements have been made of the change of temperature on adiabatic expansion of liquid He^3 in the temperature range 0.15°K to 1.15°K, at average pressures up to 22 atm. From these measurements, evaluations have been made of the expansion coefficient, α_p, at constant pressure, and of the change in entropy on compression from the saturated vapor pressure to higher pressures. The latter calculations, combined with the previously determined entropy at the saturated vapor pressure, give values of S_p, the absolute entropy under pressure. It is found that at all pressures α_p is negative up to a temperature T_0 which is a monotonically increasing function of pressure. Correspondingly, at sufficiently low temperatures $(\partial S_p/\partial p)_T$ is positive for all pressures, in agreement with theory. The S_p isobars allow plausible extrapolations to the absolute zero, from which the limiting slope at 0°K has been estimated. Comparison of these slopes with the very-low-temperature nuclear magnetic susceptibility yield some information concerning the variation with pressure of the spin-dependent interactions in liquid He^3.

536.48

225 DENSITY AND EXPANSION COEFFICIENT OF LIQUID He^3 BELOW 1°K. D.M.Lee and H.A Fairbank.
ys. of Fluids, Vol. 2, No. 5, 582-3 (Sept.-Oct., 1959).

These have been calculated from measurements between 0.14°K d 1.1°K of the dielectric constant, using the Clausius–Masotti rmula. The density has a maximum at 0.48°K. The expansion co-ficient has a minimum near 0.2°K as predicted by Goldstein bstr. 4524 of 1959). The value $\alpha_{min} = 0.012$ degree^{-1} is com-tible with $\alpha = -0.076$ T calculated for T → 0 by Brueckner and kins (Abstr. 1380 of 1959). H.London

536.48

226 HEAT TRANSFER BETWEEN COPPER AND LIQUID HELIUM II. N.J.Brow and D.V.Osborne.
il. Mag. (Eighth Ser.), Vol. 3, 1463-6 (Dec., 1958).

The Kapitza boundary resistance (K) was studied to ± 20% over e temperature range 1.4 to 2.1°K for a copper–liquid helium II undary by propagating second sound (frequency 500 c/s to 2 kc/s) om one resonator to another through a thin (0.05 mm) copper foil rrier. It was found that the dependence of 1/K on temperature is milar to that found by other workers but that the magnitude of 1/K somewhat greater; if this last result is genuine, the use of the ternating heat flow may be significant. L.Mackinnon

536.48

227 A METHOD FOR THE OBSERVATION OF HELIUM II FILMS. A.I.Shal'nikov.
. eksper. teor Fiz. Vol. 35, No. 2(8), 558 (Aug., 1058). In Russian. nglish translation: Soviet Physics–JETP (New York), Vol. 36(8), . 2, 386 (Feb., 1959).

Photo-electrons emitted from a solid surface are absorbed in lium films, which are formed on the surface. Formation of ms is accordingly investigated by measuring the photo-electric rrent. R.Eisenschitz

536.48

228 MELTING PROPERTIES OF He^3 AND He^4 UP TO 3500 kg/cm^2. E.R.Grilly and R.L.Mills.
n. Phys. (New York), Vol. 8, No. 1, 1-23 (Sept., 1959).

For He^3 and He^4 the volume change on melting, ΔV_m, the lar volume of fluid, V_f, and the fluid thermal expansion coeffic-nt, $\alpha_f[\equiv (1/V_f)(\partial V_f/\partial T)_p]$, were measured along the melting curve om 1.3 to 31°K at pressures up to 3500 kg/cm^2. These are the rst such measurements to be reported for He^3; for He^4 they are e first measurements, consistent with melting curve determina-ns, which cover this pressure range accurately. Detailed studies all the melting parameters were made at pressures below 0 kg/cm^2 for both isotopes. Two solid forms of He^3 were found th a transition line which intersects the melting curve at 3.15°K d 141 kg/cm^2. For He^4 an indirect determination was made of the tersection of the lambda line with the melting curve.

536.48

229 GROUND STATE OF THE SUPERCONDUCTOR. B.Mühlschlegel.
Phys., Vol. 156, No. 3, 235-47 (1959). In German.

Investigates the possibility of obtaining improved eigenfunctions the reduced B.C.S. Hamiltonian by forming linear combinations of e approximate B.C.S. functions. For the ground state, an admixture states with two excited pairs is considered. This leads to a wering of the ground state by an amount δW, which is independent the volume and of the same order of magnitude as the energy gap . The same shift is produced for the states with excited single irs. Superposition of states with one excited pair leads to an ditional discrete level within the energy gap.

536.48

230 COLLECTIVE EXCITATIONS IN THE THEORY OF SUPERCONDUCTIVITY. G.Rickayzen.
ys. Rev., Vol. 115, No. 4, 795-808 (Aug. 15, 1959).

The complex dielectric constant of a superconductor and the eissner effect are derived in a manner which is gauge invariant, om the theory of superconductivity due to Bardeen, Cooper, and hrieffer. The collective excitations are important in maintaining uge invariance; the longitudinal collective excitations ensure that static vector potential produces no longitudinal current and the ansverse collective excitations contribute to the Meissner current amount which depends on the angular properties of the two-body eraction. This contribution is estimated to be small. An earlier lculation of ultrasonic absorption in superconductors is justified. The whole investigation is based upon the generalized random-phase approximation introduced by Anderson and applies whether or not the Coulomb interaction between the electrons is taken into account. The equations of motion are linearized in such a way that the exchange terms are automatically screened if the Coulomb interaction is, in fact, taken into account. The region of applicability of most of the results is limited by the approximations to temperatures at or near absolute zero.

536.48

231 KNIGHT SHIFT IN SUPERCONDUCTORS. P.C.Martin and L.P.Kadanoff; J.R.Schrieffer and P.W.Anderson.
Phys. Rev. Letters, Vol. 3, No. 7, 322-3, 323-5, 325-6 (Oct. 1, 1959).

Three suggested explanations of the fact that the Knight shift (and hence the electron spin susceptibility) does not vanish in superconductors at low temperatures. Martin and Kadanoff show that the B.C.S. theory yields a non-zero susceptibility if the magnetic field is non-uniform, as in bulk metals; Schrieffer and Anderson show that even if the field is uniform, as in small particles, a non-zero susceptibility is obtained if electron scattering (at impurities or at the surface) is taken into account in setting up the ground-state wave-functions. R.G.Chambers

536.48

232 ULTRASONIC ATTENUATION IN SUPERCONDUCTING AND NORMAL MERCURY.
K.L.Chopra and T.S.Hutchison.
Canad. J. Phys., Vol. 37, No. 10, 1100-4 (Oct., 1959).

Ultrasonic attenuation in superconducting and normal mercury was studied with 20, 34, and 60 Mc/s longitudinal waves. The difference in attenuation between the superconducting and normal states below the transition temperature is greatly increased at the higher frequencies. The attenuation in the normal state is the same for both longitudinal and transverse critical magnetic fields and is independent of field strength between the critical value and 880 Oe. The results disagree in some respects with those of MacKinnon and Myers. The experimental limitations of the method as a critical test of the Bardeen–Cooper–Schrieffer theory of superconductivity are discussed.

536.48

233 SOME ULTRASONIC MEASUREMENTS IN NORMAL AND SUPERCONDUCTING ALUMINUM.
R.W.Morse and H.V.Bohm.
J. Acoust. Soc. Amer., Vol. 31, No. 11, 1523-6 (Nov., 1959).

Ultrasonic attenuation measurements in an aluminium single crystal near the superconducting transition temperature are described. These include both longitudinal and shear wave attenuations at frequencies of between 11 and 58 Mc/s and at temperatures between 1.0 and 4.2°K, as well as attenuation as a function of magnetic field in the normal state. It is found that the attenuation of shear waves at the transition temperature shows a discontinuity of about 25% of the total attenuation, this fraction being relatively independent of frequency. The longitudinal wave attenuation shows a sharp but continuous drop at the transition temperature. It is shown that the electron mean free path l can be estimated from the magnetic field dependence of the attenuation and that the condition $kl < 1$ ($k = 2\pi/\lambda$, λ being the ultrasonic wavelength) holds for the measurements. The possible significance of the shear wave discontinuity is discussed.

ELECTROSTATICS . DIELECTRICS

(The study of solids through their dielectric properties is included under Solid-State Physics; similarly for Liquid State and Gaseous State)

537.2

234 ELECTRIFICATION OF CONDUCTORS FOR DEMONSTRATION EXPERIMENTS. D.S.Ainslie.
Amer. J. Phys., Vol. 27, No. 7, 525 (Oct., 1959).

A description of two conducting devices giving consistent electrification when rubbed on the smooth surface of patent leather. A.E.Kay

537.2

235 FIELD MEASUREMENTS ON ELECTRETS AND STUDIES OF THE FORMATION OF THE HOMOCHARGE.
J.van Calker and L.van der Linde.

Z. Phys., Vol. 155, No. 4, 413-21 (1959). In German.

The field at various distances from the surface of an electret was measured by a small mica probe capacitor. The values were consistent with the measured surface charge, using a formula for the field due to Swann. The origin of the homocharge is believed to lie in direct charge transfer from the electrodes when the small airgap breaks down. Confirmatory experiments are reported.

K.W.Plessner

CURRENT ELECTRICITY ELECTROKINETICS

(The study of solids through their electrical conduction properties is included under Solid-State Physics)

537.3

236 ELECTRICAL RESISTANCE IN ACIDIC SOLUTION OF PALLADIUM AND PALLADIUM ALLOYS CONTAINING HYDROGEN. A.W.Carson, T.B.Flanagan and F.A.Lewis.
Naturwissenschaften, Vol. 46, No. 11, 374-5 (1959).

With different measuring currents identical resistance-time curves have been obtained for a palladized palladium wire which had absorbed hydrogen directly from 2N H_2SO_4 to an equilibrium concentration of H/Pd = 0.69 ± 0.01. Heating effects cannot be regarded therefore to be responsible for this resistance drift, which has only been noted in wires which readily absorb hydrogen from solution. The drift in resistance is ascribed to conduction of part of the current by hydrogen ions in the surrounding electrolyte.

R.Schnurmann

537.3 : 550.8

237 THE SCALE OF POTENTIAL PRODUCED IN A HOMOGENEOUS MEDIUM BY A RECTANGULAR IMPULSE. (FIRST APPROXIMATION). A.Belluigi.
Ann. Geofis., Vol. 12, No. 2, 149-53 (1959). In German.

A mathematical treatment of the electric potential produced by a square current pulse from an electrode in an infinite medium of low conductivity. The potential is divided into "a direct scalar potential" and a "gap potential". J.M.Hough

IONIZATION

537.56

238 IMPROVEMENT TO THE FRANCK–HERTZ EXPERIMENT. J.W.Dewdney.
Amer. J Phys., Vol. 27, No. 9, 645-6 (Dec., 1959).

Bernheim, Gossard, and Pound (Abstr. 5416 of 1957) have devised a modification of the Franck–Hertz experiment in which the traditional peaks are displayed on an oscilloscope. Minor sophistications in their method make possible the display of 25 or more

537.56

239 OSCILLOGRAPHIC INVESTIGATIONS OF CANAL [DISCHARGE] BUILD-UP IN VAPOURS. I.
J.Pfaue and H.Raether.
Z. Phys., Vol. 153, No. 5, 523-8 (1959). In German.

Describes studies of avalanche build-up in uniform-field Townsend discharges in complex (polyatomic) gases, such as ether and methylal, where, because of strong absorption, photon-induced secondary emission at the cathode is eliminated. The gap length was generally 0.8 cm. J.D.Craggs

537.56

240 CONTRIBUTIONS TO THE STUDY OF THE BI-IONIZED ELECTRIC FIELD IN THE CASE OF A CORONA WIRE AND A COAXIAL CYLINDER PRODUCING COUNTER-EMISSION.
Tran an Nhan.
J. Rech. Cent. Nat. Rech. Sci., No. 44, 215-41 (Sept., 1958).
In French.

The relationship between electrode spacing, potential difference and ion mobilities for a cylindrical mono-ionized field; the characteristics of both a cold cylindrical probe and a spherical probe in bi-ionized cylindrical fields; and the deflection of a metal sphere in a horizontal direction during free fall in a bi-ionized field are all derived theoretically and discussed. Only brief consideration is given to the incandescent probe. Apparatus for studying counter-emission, using nylon fabric about 125 μ thick to simulate the dust layer formed in an electrofilter, is described. The results of measurements of ion mobilities and potential distributions in both mono- and bi-ionized fields are given, and are applied to a practical example of an electrofilter in a consideration of the trajectories of the particles and the speed of precipitation. Finally, some data are presented for counter-emission in a field between two parallel wires.

A.E.Kay

537.56 : 621.319.7

241 A THEORETICAL ANALYSIS OF THE EFFECTS OF AN ELECTRIC FIELD ON THE CHARGING OF FINE PARTICLES. A.T.Murphy, F.T.Adler and G.W.Penney.
Trans Amer. Inst. Elect. Engrs I, Vol. 78, 318-26 (1959) = Commun. and Electronics, No. 44 (Sept., 1959).

Recent measurements of charge imparted to fine particles by unipolar ions in a strong electric field have shown that this charge is appreciably higher than that predicted by previous theoretical analyses. The charge acquired by fine particles is due primarily to ions which strike the particle by virtue of their random heat motion. Previous analyses have assumed that the only field existing was that due to the charge on the particles, thus neglecting any external field which would be present in a corona discharge. Two effects of an external field which influence charging are critically examined: (1) ions or electrons which travel in the direction of the external field toward the particle will acquire energy in addition to their heat energy: their increase in energy will allow these elementary particles to overcome more readily the potential field of the charged particle: this effect is shown to be small for molecular ions at atmospheric pressure except for only the very smallest particles but, for charging by free electrons, which have a much longer mean free path, the effect could cause a large increase in charge: (2) the presence of an external field will alter the density distribution of ions around the charged particle since this field opposes the particle field on one side of the particle and aids it on the other side. The general equation for the ion density distribution was not able to be solved. However, approximate finite difference methods using computing machinery show that this effect is important and may almost completely account for the higher charge found with molecular ion charging.

537.56

242 THE ATTACHMENT OF SLOW ELECTRONS IN CARBON MONOXIDE.
J.D.Craggs and B.A.Tozer.
Proc.Roy.Soc.A, Vol.247, 337-45 (Sept.30, 1958).

A Lozier apparatus was employed to carry out measurements of negative ion kinetic energies, and electron attachment cross-sections in carbon monoxide. The kinetic energy measurements yield an electron affinity value for oxygen lying close to the photo-ionization value. The value of attachment cross-section obtained, $2.7 \pm 0.3 \times \times 10^{-19} cm^2$, is almost an order of magnitude greater than the estimate made by Massey, based upon the results of Lozier. Measurements were also made of the cross-section for ionization of carbon monoxide in the range 0 to 100 eV.

537.56

243 THE FORMATION OF MOLECULAR IONS IN STATIC [ELECTRICAL] DISCHARGES IN THE RARE GASES.
M.Pahl.
Z.Naturforsch, Vol. 14a, No.3, 239-46, (March, 1959). In German.

A continuation of previous work (Abstr. 5766 of 1959). Data are given for He, Ne and A. Yields of atomic and molecular ions were studied as a function of discharge pressure and current, and exhaustive data are presented. J.D.Craggs

537.56 : 536.46

COMPARISON OF IONIZATION AND ELECTRONIC EXCITATION IN FLAMES. See Abstr. 212

537.56

244 DISSOCIATION OF H_2^+ IONS BY HYDROGEN.
D.R.Sweetman.
Phys. Rev. Letters, Vol.3, No.9, 425-7 (Nov.1, 1959).

Presents cross-section measurements for four dissociation processes for H_2^+ ion energies in the range 100 KeV to 1 MeV. Cross-sections for proton production appear to lie between the previously published values of Federenko (Abstr. 11135 of 1954) and C.F.Barnett [Proceedings of the Second United Nations International Conference on the peaceful uses of Atomic Energy, Geneva (1958.)].

C.G.Morgan

ELECTRIC DISCHARGES

537.52

245 THE SPATIAL DEVELOPMENT OF THE DISCHARGE FROM A POSITIVE POINT IN NONUNIFORM FIELDS IN ATMOSPHERIC AIR. E.Nasser.
Arch. Elektrotech. (Berlin), Vol. 44, No. 3, 157-67 (1959). In German.

Describes a new experimental method for the study of spatial and temporal development of discharges in which a photographic emulsion is mounted between two electrodes, and not in contact with either. Data are shown for 1/50 μsec impulses and include, e.g. "discharge diameters" for various positions in the interelectrode space. The effects of varying gap lengths and applied voltages are also studied. J.D.Craggs

537.52

246 TEMPORAL DEVELOPMENT OF THE DISCHARGE FROM A POSITIVE POINT IN NONUNIFORM FIELDS IN ATMOSPHERIC AIR. E.Nasser.
Arch. Elektrotech. (Berlin), Vol. 44, No. 3, 168-76 (1959). In German.

Describes further experiments with the technique described in the preceding abstract. Here, very short (about 10^{-9} to 10^{-8} sec) impulses are used to study the early stages of development of corona discharges. Many data, for instance on "discharge breadth" for various development times and various gap positions, and photographic records etc. are given. J.D.Craggs

537.52

247 THE APPLICATION OF SCHOTTKY'S DIFFUSION THEORY TO DISCHARGES WITH SEVERAL ION SPECIES AND EXCITED NEUTRAL PARTICLES. J.Wilhelm.
Z. Phys., Vol. 154, No. 3, 361-75 (1959). In German.

General considerations on the longitudinally homogeneous discharge column show that diffusion theory will yield an analytical solution provided the concentration ratios of the various species remain constant over the cross-section of the column. It is shown that this will be the case only if the concentration ratios bear a certain relationship to the mobilities and the coefficients in the continuity equation. Two examples of more general solutions are given. K.W.Plessner

537.52

248 THE THEORY OF DIFFUSION WAVES. I. MOVING STRIATIONS IN LOW PRESSURE DISCHARGES. H.Rother.
Ann. Phys. (Leipzig), Folge 7, Vol. 4, No. 6-8, 373-87 (1959). In German.

A "linear theory" is given with a brief reference to non-linear effects. Energy balance for the electrons is treated and dispersion effects are discussed. J.D.Craggs

537.52 : 533.5

DIRECTED GLOW DISCHARGE. See Abstr. 113

537.52 : 621.387.621.317.32

249 OSCILLOGRAPHIC MEASUREMENTS ON HIGH CURRENT SPARKS. B.Kuhn.
Ann. Phys. (Leipzig), (Folge 7), Vol. 3, No. 5-6,241-59 (1959). In German.

Describes techniques for the measurement of currents and voltage gradients, etc., in spark discharges. Currents vary up to approximately 4000 A. The resistances of spark channels are deduced. Radii are taken from streak photographs and energy densities, etc., deduced from them. J.D.Craggs

537.52

250 INCREASE OF STABILITY OF AN ARC IN A MAGNETIC FIELD AND THE PRINCIPLE OF FIELD MAXIMUM. I. G. Kesaev.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 3, 563-6 (1959). In Russian.

Measurements were made of arc duration, with a mercury cathode in non-magnetic steel equipment situated between the poles of a magnet, and its variation with field strength, the field having the same direction as the arc. Plotted on semi-log paper the graphs of duration v. field are elbowed straight lines. Arc duration with field is notably greater than without, and it is concluded that one of the primary causes of instability of arcs is the scattering of charges, and with it dispersal of energy, from the region of the cathode spot. The effect of the magnetic field is to bring about sharp diminution of this tendency with consequent improvement of stability. C. R. S. Manders

537.52

251 ON RF ELECTRODELESS DISCHARGES IN A CAPILLARY. S.Takemoto and M.Kasai.
J. Phys. Soc. Japan, Vol. 13, No. 11, 1410 (Nov., 1958).

Studied from 30 to 100 Mc/s. The intense luminous discharge set up in the capillary when a dumb-bell shaped discharge tube is placed parallel to the electric field is suggested as a useful light and ion source. No such discharge is observed when the tube is parallel to the magnetic field. G.C.Williams

537.52

252 THE RADIO INTERFERENCE PRODUCED BY CORONA DISCHARGE. M.I.Large.
J. atmos. terrest. Phys., Vol. 10, No. 5-6,245-50 (1957).

The radio interference produced by corona discharge from a single point is investigated experimentally and theoretically.

537.52 : 536.42

OBSERVATIONS ON ELECTRIC-WIRE EXPLOSIONS. See Abstr. 209

537.52

253 ELECTRICAL BREAKDOWN IN XENON AND KRYPTON AT ULTRAHIGH FREQUENCIES.
H.M.Bradford, D.M.Fraser, G.F.O.Langstroth and A.D.MacDonald.
Canad. J. Phys., Vol. 37, No. 10, 1166-70 (Oct., 1959).

Breakdown electric fields were measured in a resonant cavity for xenon and krypton gases in the pressure range of 0.05 to 100 mm of mercury, at a frequency of 2800 Mc/s. Extensive precautions were taken to ensure gas purity.

537.52

254 THE DEPENDENCE OF STATIC BREAKDOWN VOLTAGE ON THE CATHODE MATERIAL (HYDROGEN; $p \approx 500$ TORR, $d = 1$ cm). H.Mielke.
Z. angew. Phys., Vol. 11, No. 3, 111-14 (March, 1959). In German.

The time at which the breakdown of a gap occurred after the application of a voltage which was rising at a very slow known rate was measured; hence the voltage at breakdown was calculated. This voltage was found to vary with the electrode material, the values for a Cu and for a copper iodide cathode being respectively about 100 V and 400 V lower than that for a V2A steel cathode throughout the range of values of pd from 400 to 550 (mm Hg) × cm. J.Dutton

PLASMA

537.56

255 A NOTE ON THE CONFINEMENT OF CHARGED PARTICLES BY A MAGNETIC FIELD. B.Lehnert.
Ark. Fys., Vol. 15, Paper 42, 579-82 (1959).

Outlines the single-particle-containment properties of the magnetic field configuration formed by a current-carrying ring placed symmetrically inside a complete, highly conducting, sphere. A toroidal component can be given to the field by adding a straight current-carrying conductor coincident with the axis of the ring. The problem presented by leads supplying current to the ring is treated in detail. Heating methods and plasma containment properties are discussed briefly. R.S.Pease

537.56

256 PLASMA JET PIERCING OF MAGNETIC FIELDS AND ENTROPY TRAPPING INTO A CONSERVATIVE SYSTEM. J.L.Tuck.
Phys. Rev. Letters, Vol. 3, No. 7, 313-15 (Oct. 1, 1959).

Plasma of density ρ and directed velocity V will force its way into a region containing magnetic field provided the field strength does not exceed a critical value $B_c = 12 \pi \rho V^2$. Such a field strength is, however, sufficient to contain the plasma when the velocity V is randomized. The possibility of using this principle to obtain plasma trapped in a cusped-configuration of magnetic fields is discussed. R.S.Pease

537.56

257 ON THE RELATION BETWEEN HOLTSMARK'S MICRO-FIELD DISTRIBUTION FUNCTION AND THE CUTOFF VALUE OF THE COLLISION PARAMETER IN FULLY IONIZED GASES. O Theimer and H.Hoffman.
Astrophys. J., Vol. 129, No. 1, 224-35 (Jan., 1959).

The Coulomb field with cutoff at $r = p_m$, commonly used for analysing encounters of charged particles in a plasma, is replaced by a field which, on the basis of certain assumptions, is fully determined by the microfield distribution first introduced by Holtsmark (1919). Using a shielded Holtsmark distribution (Hoffman and Theimer, 1957) a scattering potential of the form

$$\Psi(r) = Zer^{-1} \exp(-ar) \cos 2.53n^{1/3}r$$

is obtained, where Ze and n are the charge and total concentration of the ions and a is a parameter depending on n and the temperature T. The diffusion coefficient $\langle(\Delta w_\perp)^2\rangle$ (Spitzer, 1956) is calculated from this potential, and the result is presented in terms of an equivalent cutoff parameter satisfying the approximate relation

$$p_m = 156T^{-1/2}n^{-1/3}$$

for most cases of practical interest. Here p_m may be a thousand times smaller than the Debye shielding constant at high temperatures and low ion densities.

537.56

258 HARMONIC GENERATION IN A CYCLOTRON RESONANT PLASMA. R.M.Hill and S.J.Tetenbaum.
J. appl. Phys., Vol. 30, No. 10, 1610-11 (Oct., 1959).

Results of experiments, using a magnetron source, on generation of harmonics in a microwave (about 3000 Mc/s) helium discharge plasma in a d.c. magnetic field, at pressures of a few microns to 1.2 mm Hg. Dependence of second harmonic output on input power, variation of magnetic field near the cyclotron value, and pressure is shown. B.Meltzer

537.56

259 ION MIRRORS AND ROTATING PLASMAS. J.Kistemaker.
Ned. Tijdschr. Natuurkde, Vol. 25, No. 7, 185-202 (July, 1959). In Dutch.

Deals in a general way with methods of heating a plasma, the reduction of energy losses and the problem of containment. Special attention is given to ion-magnetron methods as exemplified in Ixion at Los Alamos. External injection as practised in DCX (Oak Ridge, U.S.A.) and O.G.R A. (Russia) is also described. A.E.I. Research Laboratory

ELECTRON EMISSION
ELECTRON BEAMS

537.533

260 ELECTRON EMISSION DURING THE OXIDATION OF METAL SURFACES. J.Lohff and H.Raether.
Semiconductors and Phosphors (See Abstr. 9597 of 1959) pp. 583-4. In German.

This article is a brief resume of earlier articles by workers at Hamburg. A.H.W.Beck

537.533

261 OUTER FIELD EMISSION OF SINGLE CRYSTALS OF ZnS. W.Bertoldi and C.Kleint.
Ann. Phys. (Leipzig), Folge 7, Vol. 4, No. 6-8, 388-95 (1959). In German.

Field emission was observed in the dark and under illumination, after electron bombardment and after evaporating barium on to the crystals. Currents of up to 2×10^{-4} A were obtained. The field dependence of current is discussed and compared with the theoretical work of Stratton on the effect for semiconductors (see Abstr. 332 of 1956). G.F.J.Garlick

537.533

262 ELECTRON EMISSION FROM THE ARC CATHODE UNDER THE INFLUENCE OF THE INDIVIDUAL FIELD COMPONENT. G.Ecker and K.G.Müller.
J.appl. Phys., Vol. 30, No. 9, 1466-7 (Sept., 1959).

The field emission current from the cathode of a high current density arc is calculated taking into account the local variations of field near the positive ions, and is shown to be much greater than that calculated using the average space change field of the ions. It is concluded that current densities $\sim 10^6$ A/cm^2 observed in certain Hg arcs can be accounted for on the basis of field emission alone without any additional assumptions. J.Dutton

537.533 : 621.315.59 : 621.385.032.213.73

263 THE CONDUCTIVITY OF OXIDE CATHODES. Part 7. SOLID SEMICONDUCTION. G.H.Metson and E.Macartney.
Proc. Instn Elect. Engrs, Monogr. 374E, publ. Oct., 1959, 7 pp. To be republished in Pt C.

The properties of the solid conductivity state below 600°K are considered. For comparative purposes the conductivity at 420°K is given the title of "low-temperature reference conductivity σ_{420}", and this function is studied in relation to its environment. It is found that σ_{420} increases in almost linear fashion with increase of conditioning temperature and that it also increases with increase of chemical activity of the core metal. At constant temperature σ_{420} is invariant over a wide range of applied voltage and current, and shows a high order of stability with time. A most surprising result to emerge is the observed vulnerability of the solid conductivity to low-pressure oxygen attack, even at a temperature as low as 300°K.

537.533 : 621.362

264 THERMIONIC CONVERTERS. K.G.Hernqvist.
Nucleonics, Vol. 17, No. 7, 49-53 (July, 1959).

A thermionic converter consists essentially of two electrodes in vacuum. One heated electrode emits electrons thermionically which are collected on the other electrode which is cooled. High efficiencies are obtained by using collectors and emitters with suitable contact potentials. An expression for the efficiency of the device is derived and suitable electrode materials listed. Space charge effects can be reduced by positive ion neutralization, either by the injection of positive ions or by ionizing a gas (e.g. Cs vapour) in the interelectrode space with intense X-rays. The application of this device to the generation of electricity in nuclear reactors is discussed. R.D.Smith

537.533 : 621.362

265 LOS ALAMOS PLASMA THERMOCOUPLE. G.M.Grover.
Nucleonics, Vol. 17, No. 7, 54-5 (July, 1959).

A thermionic cell using a heated tantalum electron emitter and an oil-cooled copper collector in an atmosphere of ionised Caesium gas was developed. Closed circuit currents of 35 amps and open circuit voltages of 3.8 volts have been obtained. Effects of Cs pressure and emitter temperature were investigated. Details are given of a fission powered thermocouple with ZrC:UC fuel pin as emitter and a stainless steel collector which converts fission heat directly into electricity. R.D.Smith

537.533 : 621.383.4

266 THE DESIGN OF SINGLE-CRYSTAL INFRA-RED PHOTOCELLS. C.Hilsum and O.Simpson.
Proc. Instn. Elec. Engrs, Paper 2965E [International Convention on Transistors and Associated Semiconductor Devices], publ. 1960 (Part B Suppl. 15, 398-401).

Explicit formulae are given for the sensitivity of single-crystal photocells used as photoconductive, photoelectric and p–n junction detectors. The equivalent noise input can be expressed as the product of functions depending on the bulk and surface properties respectively. The parameters governing the design of photocells of high sensitivity are discussed, and the results are applied to the semiconductors indium antimonide, indium arsenide and lead sulphide. It is shown that the best mode of operation for a semiconductor may be inferred from the carrier mobility, lifetime and surface recombination velocity.

537.533

267 EMISSION OF SECONDARY ELECTRONS UNDER THE ACTION OF Li, B AND N WITH ENERGY UP TO 10 MeV. A.I.Akishin and S.S.Vasil'ev.
Fiz. tverdogo Tela, Vol. 1, No. 5, 833-4 (May, 1959). In Russian.

Describes briefly an experimental investigation of the dependence of the γ-coefficient on the energy of these ions, bombarding an activated Cu–Be alloy target. The ions (from a cyclotron) had energies from a few hundred keV up to 10 MeV. It is concluded from the results that for heavier ions correspondingly higher values

the γ-coefficient occur, with the same energy of primary ions. his agrees with the results obtained for lower energy ions (Abstr. 17 of 1955). J.M.Zarzycki

537.533

268 ELECTRON EMISSION FROM THE SURFACE OF PURE MOLYBDENUM AFTER BOMBARDMENT BY ELECRONS. M.V.Sinel'nikov.
okl. Akad. Nauk SSSR, Vol. 126, No. 3, 554-6 (May 21, 1959). Russian.

Describes experiments on the emission of particles (assumed be electrons) from the surface of a pure molybdenum electrode ter bombardment with a weak electron beam at a room tempera- re. In all experiments the emission decreased with time in llowing order: 1 min after bombardment the emission current as 10^{-11} A; 30 min after bombardment, 1.3×10^{-12} A; 10 hr after mbardment, 10^{-14} A. It was also found that the majority of elec- ons had energy equal to the maximum energy (7 keV) of the bom- rding electrons. J.M.Zarzycki

537.533 : 621.385.2

269 PLANAR DIODE FLOW AND THE LANGMUIR LIMIT. H.Moss.
Electronics and Control, Vol. 6, No. 5, 403-14 (May, 1959).

Assuming only Newton's 2nd law of motion and the Maxwellian nission energy spectrum of electrons from a thermionic cathode e expression $\rho_z = \rho_c(eV/kT)\sin^2\alpha$ is established for the current nsity at any plane in a parallel planar diode, due and only due, to ectrons arriving through a semi-angle α where $\alpha \to 0$. This is an ample of the expression originally derived by Langmuir [Proc. st. Radio Engrs, Vol. 25, 977 (1937)], for the case where $V/kT \gg 1$ but there is here no appeal either to the Abbe sine law to the Lambert cosine law. However, it is shown in the Appendix at the Lambert cosine law is merely an inevitable consequence of e form and identity of the axial and radial emission velocity ectra, and is hence implied by the nature of the equation used to press the Maxwellian initial energy conditions.

537.533

270 CONCENTRATION OF ELECTRON BEAMS OF LOW POTENTIAL AND HIGH CURRENT DENSITY USING N ELECTRIC FIELD IN HELIUM. A.Franz.
tta phys. Austriaca, Vol. 12, No. 4, 412-26 (1959). In German.

Experimental investigation of the shape of electron beams in a lium atmosphere of some 10^{-3} torr and with a retarding electric ld. The beam (1-2 mA and about 250 eV) is produced by a Pierce m, and is of initial width 1 mm and length 50 cm. The results, found otographically, especially those on location of nodes in the beam, e explained by a simplified theory. B.Meltzer

537.533

271 AN EXTENSION OF THE RANGE OF APPLICATION OF THE FOCAL LENGTH FORMULA FOR APERTURE LENSES. J.Hoeft.
angew. Phys., Vol. 11, No. 10, 380-2 (Oct., 1959). In German.

The focal length of an aperture lens is given by $f = 4V/(E_2 - E_1)$, here V is the potential of the (small) aperture, and E_1 and E_2 the ectric field on either side of the aperture. By replacing V by V*, e axial potential, and assuming a linear increase of potential ross the aperture, the formula yields a good approximation for ertures of finite dimensions. A.E.I.Research Laboratory

537.533 : 530.16

PROPOSED TEST OF UNCERTAINTY PRINCIPLE, USING IELD-EMISSION MICROSCOPE. See Abstr. 46

537.533

272 THE INTENSITY PROFILES OF ELECTRON DIFFRACTION LINES. T.B.Rymer and F.J.Fayers.
nil. Mag. (Eighth Ser.), Vol. 3, 1137-53 (Oct., 1958).

The paper discusses the intensity profiles of electron-diffrac- on rings from a polycrystalline specimen with random orientation. eoretical expressions are given for the profiles due to (a) the nite size of the crystals, (b) random stresses in the specimen,) dynamical refraction. The profiles of diffraction rings formed specimens of vacuum-evaporated lithium fluoride and gold were udied using an electron-diffraction camera and microphotometer pable of a resolution better than 10 μ. It is found that the profiles lithium fluoride diffraction rings are consistent with the assump- on that the crystals are cylinders of diameter ~ 140 A having their es normal to the specimen plane and subject to random stresses the plane of the specimen having a standard deviation ~ 4×10^9 dyn/cm^2. The profiles of gold diffraction rings are consistent with the assumption that the width of the rings is due to dynamical refraction by crystals bounded by parallel (100) faces and subject to random stresses in the plane of the specimen having a standard deviation ~ 10^{10} dyn/cm^2.

537.533 : 539.2

273 THE FORMULATION OF ELECTRON DIFFRACTION BY MEANS OF A SCATTERING MATRIX AND ITS PRACTICAL APPLICABILITY. H.Niehrs.
Z. Naturforsch., Vol. 14a, No. 5-6, 504-11 (May-June, 1959). In German.

The process of diffraction of an electron beam is described in terms of the operation of a matrix on a vector whose components are the amplitudes of beams travelling in a set of discrete directions. An illustration is given of the evaluation of the diffraction pattern; it involves much less arithmetical work than the method of finding eigen-waves. See Sturkey, Acta Cryst., Vol. 10, Pt 12, 858-9 (1957). A.R.Stokes

537.533

274 ORIGIN OF THE CHARACTERISTIC ELECTRON ENERGY LOSSES IN ALUMINUM.
C.J.Powell and J.B.Swan.
Phys. Rev., Vol. 115, No. 4, 869-75 (Aug. 15, 1959).

The characteristic electron energy loss spectrum was measured by analysing the energy distribution of 760, 1000, 1520, and 2020 eV electrons scattered by an evaporated specimen through 90°. Twelve loss peaks were observed, made up of combinations of elementary 10.3 and 15.3 eV losses. The former, the low-lying loss, is identified with the lowered plasma loss proposed by Ritchie, and the latter with the plasma loss proposed by Bohm and Pines and previously observed by many other workers. In measurements made with very thin evaporated targets, it was found that the low-lying loss changed considerably in position, as well as in intensity relative to the 15.3 eV loss. These changes, which are interpreted in terms of Ritchie's theory, definitely indicate that the low-lying loss is influenced by the surface layers of the specimen. As targets of high surface and volume purity could be prepared, it is concluded that results obtained by the present reflection technique, when examining loss behaviour affected by surface phenomena, are superior to measurements of the characteristic loss spectrum of electrons transmitted through thin films.

537.533

275 ON THE MULTIPLE SCATTERING AND BACK DIFFUSION OF FAST ELECTRONS ON PASSING THROUGH THICK FILMS. H.Frank.
Z. Naturforsch., Vol. 14a, No. 3, 247-61 (March, 1959). In German.

The angular and energy distributions of fast (1.75 MeV) electrons scattered by thick foils have been determined both for perpendicular and oblique incidence, particular attention being paid to the onset of the state of complete diffusion. The dependence of the intensities of both forward and backward scattered electrons on foil thickness and atomic number are shown in a series of graphs.
A.E.I. Research Laboratory

ION EMISSION . ION BEAMS

537.534

276 MASS-SPECTROMETRIC INVESTIGATION OF THE THERMIONIC EMISSION OF CAESIUM FROM VARIOUS EMITTERS. G.M.Panchenkov, A.M.Kolchin and P.A.Akishin.
Fiz. tverdogo Tela, Vol. 1, No. 6, 919-22 (June, 1959). In Russian.

Describes in detail the preparation of caesium ion sources based on aluminium silicates. The experimental investigation was carried out on four Cs ion emitters based on: (1) Al silicate; (2) alumina gel; (3) silica gel; (4) Cs sulphate. It was found that: (1) the emission of Cs ions from chemically different emitters varies with temperature as exp(−E/kT), where E is the activation energy; (2) activation energy is independent of the chemical composition of the emitter and was found to be 2.7 eV; (3) ion current depends on the concentration of Cs in the emitter; (4) diffusion processes in the emitters have no effect on the emission. It was found also that electrical conductivity of an emitter based on Al silicate varies with temperature as exp(−W/kT), where W is the activation energy, of the order of 1 eV. J.M.Zarzycki

537.534

277 THEORY OF THE ION BEAM IN ELECTROSTATIC FIELDS TAKING SPACE-CHARGE INTO ACCOUNT.
N.Pucker.
Acta phys. Austriaca, Vol. 12, No. 4, 475-91 (1959). In German.

Firstly presents a matrix formalism of Timm (Abstr. 401 of 1956) for calculating the paths of paraxial rays in a given electrostatic field, and applies it to an ideal two-cylinder lens with linear variation of potential between two field-free regions. Then a first-order perturbation calculation of the effect of the space-charge field of the beam, assumed small, is carried out, results being given explicitly in terms of measurable quantities. B.Meltzer

537.534

278 RADIATION FROM A MODULATED BEAM OF CHARGED PARTICLES IN FLIGHT THROUGH A ROUND OPENING IN A PLANE SCREEN.
Yu.N.Dnestrovskii and D.P.Kostomarov.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 4, 792-5 (1959). In Russian.

An integral equation, governing the process in question, was set up and solved by an electronic computor. Results were obtained for velocities $0.1 \leq v/c \leq 0.99$ and for $0.5 \leq ka \leq 4$, where k is the wave number and a the radius of the opening. Various asymptotic cases are also discussed in the paper. P.Roman

537.534

279 STUDY OF ULTRA-RELATIVISTIC CHARGED PARTICLES DURING THE PASSAGE THROUGH A CIRCULAR HOLE IN A SCREEN.
Yu.N.Dnestrovskii and D.P.Kostomarov.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 5, 1026-9 (1959). In Russian.

An axially symmetrical, modulated beam of ultra-relativistic, charged particles is passed through a circular hole in a perfectly conducting screen. Using previously obtained asymptotic expressions for the electro-magnetic field components of the system, (see preceding abstract), the authors derive the charge and the spectral energy distribution in the beam. The latter (for $v/c \sim 1$) is proportional to a function $f_0(\mu)$ where $\mu = l/a$ (l = length of beam, a = radius of the hole); as μ varies from 0 to 10, $f_0(\mu)$ decreases from 1 to 0.5. Since the maximum spectral density lies in the region of low frequencies, the total energy does not depend greatly on the velocity of the beam. It is suggested that this effect should be noted during the design of accelerators of ultra-relativistic charged particles. J.K.Skwirzynski

537.534

280 NUMERICAL CALCULATION OF THE POTENTIAL DISTRIBUTION IN ION SLIT LENS SYSTEMS. I.
A.J.H.Boerboom.
Z. Naturforsch., Vol. 14a, No. 9, 809-16 (Sept., 1959).

The potential distribution is calculated in an ion lens, consisting of three parallel collinear slits in three parallel electrodes. The slit system is supposed to be infinite in the direction of the slits, so the problem becomes two dimensional in a plane perpendicular on the direction of the slits. In this plane the potential distribution is calculated by the method of conformal transformation. The Schwarz–Christoffel transformation is used to map conformally the region between the projections of the electrodes of the slit system. It proves to be very simple to perform this transformation. Formulae are given for the case of an ion lens consisting of slits in three parallel plates. A series expansion and an iteration method are developed to find the necessary parameters. Both methods prove to be satisfactory if the slit widths are smaller than the distance to the neighbouring electrodes. Symmetrical lenses, not satisfying this condition, will be treated in a second paper. In a third paper slit system will be treated with an arbitrary number of electrodes. In the transformed region Laplace's equation is solved, having as boundary conditions the potentials on the electrodes. In this way the exact potential distribution in the lens system is found. In a typical example the potential distributions are calculated along the axis for several potentials on the electrodes, together with the corresponding fields.

537.534

281 CALCULATION OF THE ION OPTICAL PROPERTIES OF INHOMOGENEOUS MAGNETIC SECTOR FIELDS, II THE SECOND ORDER ABERRATIONS OUTSIDE THE MEDIAN PLANE. H.Wachsmuth, A.J.H.Boerboom and H.A.Tasman.
Z.Naturforsch., Vol. 14a, No. 9, 818-22 (Sept., 1959).

For Pt I, see Abstr. 7096(1959). The second-order aberrations are calculated outside the median plane referring to focusing in the radial direction. The influence of fringing fields is neglected, and the field boundaries are supposed to be plane and normal to the main path at the point where it enters and leaves the field.

537.534

282 CALCULATION OF THE ION OPTICAL PROPERTIES OF INHOMOGENEOUS MAGNETIC SECTOR FIELDS III. OBLIQUE INCIDENCE AND EXIT AT CURVED BOUNDARIES.
H.A.Tasman, A.J.H.Boerboom and H.Wachsmuth.
Z.Naturforsch., Vol. 14a, No. 9, 822-7 (Sept., 1959).

The calculations of the previous papers (see preceding abstract) are extended to include the effect of oblique incidence and exit at curved boundaries. The influence of the fringing fields on axial focusing, when the boundaries are oblique, is accounted for. It is shown that the second-order angular aberration may be eliminated by appropriate curvature of the boundaries.

537.534

283 STUDY AND REALISATION OF A MASS SPECTROMETER OF THE OMEGATRON TYPE. APPLICATION TO LEAK DETECTION AND GAS ANALYSIS AT LOW PRESSURES.
R.J.Warnecke.
Ann. Radioelect., Vol. 14, 339-65 (Oct., 1959). In French.

Deals with both theoretical and experimental aspects of the omegatron mass spectrometer. The effect on the ideal trajectory of the finite initial velocities of the ions and the effect of magnetic and other misalignments are discussed. Finally, two practical instruments are described; one is for gas analysis below 10^{-5} mm Hg and the other is for leak detection. Typical spectra are shown and the practical limitations of the device are discussed. A.E.I. Research Laboratory

PARTICLE ACCELERATORS

537.54

284 EARLY DEVELOPMENT OF PARTICLE ACCELERATORS. M.S.Livingston.
Amer. J Phys., Vol. 27, No. 9, 626-9 (Dec., 1959).

Professor Ernest O. Lawrence of the University of California conceived the idea of the cyclotron in 1929 and reported the principle in Science in 1930. The first successful experimental demonstration of cyclotron resonance was by Livingston in a Doctorate Thesis completed in April, 1931, using a 4 in. pole magnet and producing H_2^+ ions of 80 000 eV energy. By late 1931 Lawrence and Livingston completed an 11 in. cyclotron which produced H^+ ions of 1.2 MeV, and which was used with others in the laboratory for disintegration experiments. By late 1932 the "27 in." cyclotron was completed and was in service for research experiments; the energy and intensity were steadily increased during 1933 and 1934 and both H_2^+ and D^+ ions of up to 5 MeV energy became available. During these early years many young scientists joined the group to do research on disintegration reactions, neutron properties, and induced radioactivity, under the stimulating leadership of Professor Lawrence.

MAGNETISM

(The magnetic properties of solids are included under Solid-State Physics; similarly for Liquid State and Gaseous State)

538.1 : 537.534

285 SHAPE OF THE MAGNETIC FIELD BETWEEN CONICAL POLE FACES.
A.J.H.Boerboom, H.A.Tasman and H.Wachsmuth.
Z. Naturforsch., Vol. 14a, No. 9, 816-18 (Sept., 1959).

Calculation is made of the shape of a field, which may be used as an inhomogeneous deflecting field for a mass spectrometer. The results are expressed as a series expansion in the coordinates around the main path, and in the gap width at the radius of the main path.

538.2 : 537.2

286 PROJECTIONS OF DIPOLE FLUX PATTERNS. M.Correll.

mer. J. Phys., Vol. 27, No. 8, 587-8 (Nov., 1959).

A method of making projections of three-dimensional flux atterns is described. The resulting figures are shown for cases here the dipole axis and the picture plane make angles of from ° to 70° in steps of 10°.

538.2 : 537.533

287 THE USE OF MAGNETIC MODELS IN THE INTERPRETATION OF DOMAIN EFFECTS ON AN ELECTRON EAM. M.Blackman and N.D.Lisgarten.

hil. Mag. (Eighth Ser.), Vol. 3, 1069-73 (Oct., 1958).

A magnetic unit was constructed which consists of an array of ppositely magnetized steel wires and its effect on an electron beam as studied. The phenomena observed are similar to the domain ffects found when magnetic crystals are examined in the same pparatus, and are used in interpreting some of the features of the omain effects.

538.27

288 CONSTRUCTION OF A MAGNETIC ATOMIC BEAM RESONANCE APPARATUS.

.von Ehrenstein, G.Fricke and P.Pietsch.

. Phys., Vol. 156, No. 3, 411-15 (1959). In German.

The apparatus is for use with an ionization detector consisting f a mass sepctrometer with electron-bombardment ionizer. The otal beam length is 127 cm. The A-field has a length of 15 cm and maximum inhomogeneity of about 36 000 G/cm; the B-field has a ength of 40 cm and a maximum inhomogeneity of about 16 000 G/cm; e (homogeneous) C-field has a length of 15 cm. All magnet-coils re mounted outside the vacuum-chamber. Adjustment is made by uxiliary obstacle wires.

ELECTROMAGNETISM MAGNETOHYDRODYNAMICS

538.3

289 STUDY OF THE NON-RELATIVISTIC MOTION OF A CHARGED PARTICLE IN A [UNIFORM] MAGNETIC FIELD IN THE PRESENCE OF A PLANE ELECTROMAGNETIC WAVE PROPAGATED IN THE DIRECTION OF THE FIELD. G.Sacerdoti.

Atti Accad. Sci. Torino I, Vol. 93, No. 2, 530-6 (1958-59). In Italian.

538.3

290 THE STUDY OF SOME MAGNETIC FIELDS BY USING ANALOGOUS SYSTEMS. F.C.Germain.

Ann. Phys. (Paris), Ser. 13, Vol. 14, No. 1-2, 5-45 (Jan.-Feb., 1959). In French.

Describes some new applications of the electric tank to the solution of problems in electromagnetism. The theory and the experimental arrangements are discussed in detail. P.M.Davidson

538.3

291 A REMARKABLE CLASS OF ELLIPSOIDAL FIGURES OF REVOLUTION OF A UNIFORMLY ROTATING SELF-GRAVITATING MAGNETOHYDRODYNAMIC FLUID MASS. C.Agostinelli.

Atti Accad. Sci. Torino I, Vol. 93, No. 2, 369-81 (1958-59). In Italian.

The fluid is assumed incompressible and perfectly conducting and rotates about the axis of symmetry. The shape of the surface is determined by the balance between magnetic, centrifugal, self-gravitational, and hydrostatic forces. An exact particular stationary solution for the magnetic field both inside and outside the fluid is studied. O.Penrose

538.3 : 523.85

292 ON THE TRANSFERENCE OF ANGULAR MOMENTUM BY HYDROMAGNETIC WAVES IN A PRIMEVAL NEBULA. P.C.Kendall.

Astrophys. J., Vol. 129, No. 1, 194-204 (Jan., 1959).

Considers a mechanism whereby angular momentum is transferred from one highly conducting region to another by hydromagnetic waves through an ambient magnetic field. The transfer is investigated of linear momentum by hydromagnetic waves between one region of initially moving ionized gas and another region of initially stationary ionized gas. This will be unaffected after a time if the two regions are separated by a gas of very low density. The critical ratio is derived of the dimensions and density of the two regions that determines whether or not the initially stationary ionized gas can acquire most of the linear momentum. Using these exact results for comparison, an investigation is made by an order-of-magnitude argument of the corresponding problem of a primitive sun with a magnetic field rotating in an infalling cloud of ionized gas or a solar nebula. The processes could have ocurred during the formation of the solar system, but Alfvén's theory (1954) appears to require a much larger field for the primitive sun than if one assumes larger densities for the solar nebula. An obliquely rotating dipole is more favorable to the process than an axially symmetric one.

ELECTROMAGNETIC WAVES AND OSCILLATIONS

538.56 : 530.14

293 QUANTUM PHENOMENA IN THE RADIO WAVE REGION. V.M.Fajn [Fain].

Fortschr. Phys., Vol. 7, No. 6, 329-7 (1959). In German.

Translation of original paper in Uspekhi fiz. Nauk, Vol. 64, No. 2, 273-313 (1957). See Abstr. 7116 (1958).

538.56

294 THE REALIZATION OF A SELF-OSCILLATOR OF THE MASER TYPE IN A STRONG FIELD. C.Fric.

C.R. Acad. Sci. (Paris), Vol. 249, No. 1, 80-2 (July 6, 1959). In French.

Following previous work, conditions are described for successful operation of an oscillator at 29.66 Mc/s using nuclear spins. D.J.Oliver

538.56 : 529.7 : 621.373.5 : 621.317.76

FREQUENCY VARIATIONS OF QUARTZ OSCILLATORS AND THE EARTH'S ROTATION IN TERMS OF THE N.P.L. CAESIUM STANDARD. See Abstr. 21

538.56 : 536.48

295 LIQUID HELIUM CRYOSTAT WITH AN INTEGRAL SUPERCONDUCTING RESONATOR.

E.Maxwell and A.F.Schmidt.

Bull. Inst. Internat. Froid, Annexe 1958-1, 95-101.

The superconducting cavity resonator made of electroplated lead on brass is designed for use at several hundred Mc/s and has a Q of 400 000. The demountable cryostat designed for the resonator consists of an outer container for liquid nitrogen and an inner one for liquid helium, each being insulated by high vacuum. Storage times of 42 days for liquid helium and 12 days for liquid nitrogen have so far been achieved in the cryostat. R.C.Kell

538.56

296 APPLICATION OF THE GENERALIZED MAGNETO-IONIC THEORY TO THE PROPAGATION OF RADIO WAVES AT THE MAGNETIC DIP-POLES OF THE EARTH. C.Lakshmi Bai.

J. atmos. terrest. Phys., Vol. 11, No. 1, 31-5 (1957).

The generalized magneto-ionic theory of Booker is applied to the propagation of radio waves at the magnetic dip-poles of the earth, to obtain rigorous values for the levels of reflection in the ionosphere, of the magneto-ionic components. The propagation is discussed for various angles of incidence and for operating frequencies greater and less than the magneto-ionic frequency. The application of these results for finding out the maximum usable frequency for a given transmission distance at the magnetic dip-poles is indicated.

538.56

297 DIFFRACTION PATTERNS OF SMALL PHASE OBJECTS MEASURED IN THE MICROWAVE REGION. O.Bryngdahl.

Ark. Fys., Vol. 16, Paper 6, 69-92 (1959).

Measurements were made on the diffraction patterns of circular phase objects by means of microwaves of 5.15 cm wavelength. The intensity of radiation in the electric plane was measured along

the axis and close behind the diffracting object in several planes transverse to the incident beam direction. The patterns are compared with theoretical computations obtained using a modification of the Huygens–Kirchhoff theory of diffraction. Satisfactory agreement between experimental and theoretical curves was obtained.

538.56 : 534.26

298 THE EXCITATION, REFLECTION AND RADIATION OF SURFACE WAVES AT A WEDGE WITH GIVEN IMPEDANCE FACES. G.D.Malyuzhinets.
Dokl. Akad. Nauk SSSR, Vol. 121, No. 3, 436-9 (1958). In Russian.

The author takes polar coordinates (r,ϕ) in a plane perpendicular to the infinitely long rib of the wedge and provides a brief general solution of the problem of the diffraction of a plane wave of the form $p_0 = \exp[-ikr\cos(\phi - \phi_0)]$. The particular case is then discussed when the angle of incidence ϕ_0 is equal to the Brewster angle, i.e. $\phi_0 = \Phi - \Theta_+$ or $\phi_0 = -\Phi + \Theta_-$, where $\sin\Theta_\pm = z_0/z_\pm$, $z_0 = \rho c$ is the wave impedance of the medium, and $z_\pm$ are the normal impedances of the wedge faces $\phi = \pm\Phi$. If $\mathrm{Re}\,\Theta_\pm = 0$, $\mathrm{Im}\,\Theta_\pm < 0$, this corresponds to the arrival from infinity of undamped surface waves. If $\mathrm{Im}\,\Theta_\pm > 0$, the analogous waves cannot reasonably be called surface waves since their amplitude now increases instead of decreases on moving away from the surface. D.E.Brown

538.56 : 534.2

RELATIONS BETWEEN THE VARIATIONS IN AMPLITUDE AND PHASE IN THE PROPAGATION OF VIBRATORY PHENOMENA. See Abstr. 120

538.56 : 534.2

INFLUENCE OF THE ENVIRONMENT ON THE WAVE TRANSMISSION OF ENERGY: RESONANCE AND RELAXATION. See Abstr. 121

538.56 : 621.396.821.3

299 A NOTE ON THE STATISTICAL THEORY OF RADIO-WAVE PROPAGATION OVER AN IDEALLY CONDUCTING PLANE. É.A.Kaner and F.G.Bass.
Dokl. Akad. Nauk SSSR, Vol. 127, No. 4, 792-5 (Aug. 1, 1959). In Russian.

Assumes a propagation medium with small chance fluctuations $\delta\epsilon$ of the dielectric constant $\epsilon = \langle\epsilon\rangle + \delta\epsilon$, where $\langle\epsilon\rangle$ and $\langle\delta\epsilon^2\rangle$ are assumed independent of time and the coordinates. The source is a dipole situated above the boundary plane. Only large scale fluctuations are considered, i.e. where the characteristic correlation radius is large compared with the wave-length. Starting from Maxwell's equation, the presence of the boundary is shown to lead to a sharp increase in the relative fluctuations as compared with the case of an infinite medium; these increases occur near the interference minima of the regular field component. The cases of a curved and a finitely conducting boundary are also discussed. D.E.Brown

538.56 : 621.396.812.3

300 FLUCTUATIONS OF PHASE-FRONTS IN THE PROPAGATION OF TEN-CENTIMETRE RADIO-WAVES OVER THE SEA-SURFACE.
A.V.Men',S.Ya.Braude and V.I.Gorbach.
Dokl. Akad. Nauk SSSR, Vol. 125, No. 5, 1019-22 (April 11, 1959). In Russian.

A detailed experimental investigation of the fluctuations of the phase-fronts was performed. The 10-cm waves had vertical polarization; the experimental area was 33 km wide; the transmitting aerial was mounted 9,18 and 35 m, respectively, over the sea surface. The experiments were carried out both under summer and winter conditions. Phase-fluctuations with the frequencies 0.01 to 100 kc/s could be observed. Results of the many observations were classified into four groups. In general, fluctuations of the phase-differences followed the law of normal distribution. P.Roman

538.56

301 SCATTERING CROSS-SECTION OF A CIRCULAR DISK SITUATED IN THE FIELD OF A PLANE ELECTROMAGNETIC WAVE WITH A NONUNIFORM AMPLITUDE DISTRIBUTION. P.Szulkin.
Bull. Acad. Polon. Sci. Ser. Sci. Tech., Vol. 7, No. 4, 279-83 (1959). In French.

The amplitude distribution is assumed to be of the form:

$$(n_1 + m_1\cos a_1x)(n_2 + m_2\cos a_2y),$$

where x,y are the cartesian coordinates and a,n,m are constants. The scattering cross-section of a circular disk is obtained explicitly by quadrature, in terms of Bessel functions of these constants and of the disk radius. J.K.Skwirzynski

538.56

302 THE ELECTROMAGNETIC FIELD IN A HORN WAVE-GUIDE IN THE NEIGHBOURHOOD OF THE ANGLE. P.Szulkin.
Bull. Acad. Polon. Sci. Ser. Sci. tech., Vol. 7, No. 5. 327-31 (1959). In French.

A brief discussion of the solution of Maxwell's equations for a conical guiding surface and of the modes which can exist therein. G.D.Sims

538.56 : 537.56

303 A VARIATIONAL METHOD FOR THE PROPAGATION OF E.M. WAVES IN A PLASMA.
L.Gabarre and L.Cairó.
C.R. Acad. Sci. (Paris), Vol. 249, No. 18, 1750-2 (Nov. 2, 1959). In French.

A first approximation is obtained to the propagation constant of the perturbed TE_{10} wave which propagates in a rectangular waveguide containing a thin layer of plasma in contact with the broad face. A variational procedure is used (Abstr. 1624 of 1959) in which, to a first order, the magnetic field is assumed to be proportional to that existing in the empty guide. G.D.Sims

538.56 : 621.396.812.5

304 LONG-PATH V.L.F.—FREQUENCY VARIATIONS ASSOCIATED WITH THE SOLAR FLARE OF 23 FEBRUARY 1956. A.H.Allan, D.D.Crombie and W.A.Penton.
J. atmos. terrest. Phys., Vol. 10, No. 2, 110-13 (1957).

The frequency and phase variations of GBR on 16 kc/s as received in New Zealand during the solar flare of 23 February 1956 are described and compared with the effects during a normal flare. The difference is attributed to the cosmic-ray increase accompanying the 23 February flare.

538.56 : 525 : 621.396.969.35 : 621.396.946

ELECTROMAGNETIC WAVES AND SATELLITES. HIGH-FREQUENCY ECHOES FROM IONIZED TRAILS OF SATELLITES. See Abstr. 15

538.56

305 THE FOCUSING OF SHORT RADIO WAVES REFLECTED FROM THE IONOSPHERE. J.D.Whitehead.
J. atmos. terrest. Phys., Vol. 9, No. 5-6, 269-75 (1956).

Short-lived increases in the mean amplitude of waves reflected from the ionosphere F region are shown to be the result of focusing effects caused by large-scale distortions moving horizontally. The velocity of the movement can be determined from simultaneous observations of changes in the amplitude and the phase. There is a marked diurnal variation in the number of amplitude increases caused by focusing.

538.56

306 THE ABSORPTION OF RADIO WAVES IN AN IONOSPHERIC LAYER. J.D.Whitehead.
J. atmos. terrest. Phys., Vol. 9, No. 5-6, 276-81 (1956).

The absorption of radio waves travelling vertically through or reflected in a Chapman layer is investigated by a method which takes into account the presence of the earth's magnetic field. The distribution of the absorption along the path is considered, and it is shown that when the wave is reflected inside the layer an important contribution to the absorption occurs near the level of reflection.

538.56

307 SOME MEASUREMENTS OF IONOSPHERIC ABSORPTION AT DELHI.
S.N.Mitra and S.C.Mazumdar.
J. atmos. terrest. Phys., Vol. 10, No. 1, 32-43 (Jan., 1957).

The results of some measurements of ionospheric absorption taken at Delhi during June 1954 to December 1955 are described. The measurements were carried out on 5 and 2.5 Mc/s. A brief description of the experimental setup is included. The analysis of data shows that the diurnal variation of absorption gives

$$|\log\rho| \propto (\cos\chi)^{0.52}$$

The value of αN has been indicated from the observed value of the

relaxation time". The absorption at night has been observed to be onsiderable at this latitude. It has been postulated from the low value f the exponent in the diurnal variation factor, the magnitude of the elaxation time, and from direct measurements of absorption on s and F echoes, that the main absorption is probably taking place in ie D region.

538.56

308 THE CALCULATION OF GROUP VELOCITY IN MAGNETO-IONIC THEORY. R.F.Mullaly.
atmos. terrest. Phys., Vol. 9, No. 5-6, 322-5 (1956).

It is shown how the magneto-ionic group refractive index μ' may be alculated as a function of the direction of propagation θ by expres-ng both these quantities in simple form in terms of a parameter which is given a series of values. A similar method gives μ' as function of the electron density for a fixed value of θ. The simpli-ed formulae given here are suitable for use with a desk calculator.

538.56

309 THE NONDEVIATIVE ABSORPTION OF HIGH-FREQUENCY RADIO WAVES IN AURORAL LATITUDES.
Chapman and C.G.Little.
atmos. terrest. Phys., Vol. 10, No. 1, 20-31 (Jan., 1957).

In auroral latitudes the nondeviative absorption of high-frequency adio waves is much more irregular, and often much stronger, than subauroral latitudes. It is greater and more frequent by day than night; this is the converse of the daily variation of magnetic activ-y. The electrons that produce the absorption in subauroral latitudes are mainly caused by solar ultra-violet light; in auroral latitudes, often the major source is bombardment of the atmosphere by solar gas. According to Van Allen's new interpretation of the soft radiation observed in auroral latitudes, down to 50 km, a small minority of the primary bombarding particles generate X-rays, which penetrate further than the particles themselves. It is suggested that the layer ionized by these X-rays is an important factor in the daytime radio absorption. Also Lyman-alpha radiation is generated by the auroral protons, ionizing nitric oxide molecules which may contribute appreciably to the absorption. Tables are given, indicating ionospheric conditions consistent with greater daytime absorption than at night, even when the bombardment is twenty times more intense than that by day.

Radiofrequency Spectroscopy Techniques

538.56

310 SIMPLE MICROWAVE RESONANCE SPECTROMETER. E.S.Gravlin and J.A.Cowen.
Amer. J. Phys., Vol. 27, No. 8, 566-8 (Nov., 1959).

A relatively simple and inexpensive apparatus for the observation of electron paramagnetic resonance at microwave frequencies is described. The apparatus is designed for the undergraduate laboratory but, with some modification, may be used as a research tool.

NUCLEAR AND ATOMIC PHYSICS

539

311 RÉSUMÉ OF ATOMIC CONSTANTS. J.A.Bearden and J.S.Thomsen.
mer. J. Phys., Vol. 27, No. 8, 569-76 (Nov., 1959).

Some of the more interesting conclusions of the 1955 survey of tomic constants were the following. (1) Most familiar experiments escribed in general physics courses now carry negligible weight. (2) Probable errors in values of the constants are of the order of 0 p.p.m. (3) Use of X-ray "h/e experiments" was a source of error a previous evaluations; theoretical interpretation of these results nvolves considerable uncertainty. (4) Electrochemical values of ne Faraday are now in fair agreement, but their mean differs ignificantly from the value obtained by electromagnetic experiments. 5) There is still some evidence for variation of the velocity of light ith frequency; however, the negative case appears stronger and is rther strengthened by newer data. Recent developments are dis-ussed and the authors' analysis compared with the 1955 study of ohen, DuMond, Layton and Rollet (Abstr. 2330 of 1956). Recom-ended values for principal constants are given. These include a orrection for an error in the Karplus and Kroll calculation of the nomalous moment of the electron, but do not reflect any experi-ental data reported since 1955.

APPARATUS . PARTICLE DETECTORS

539.1.07

312 METHODS FOR DETERMINING THE FLUCTUATION OF THE ENERGY AND OF THE ANGULAR DISTRIBUTIONS F FAST IONIZING PARTICLES.
.Békéssy, L.Pál and L.Jánossy.
cta phys. Hungar., Vol. 9, No. 3, 297-316 (1959). In Russian.

The methods are described and critically compared. Special ttention is paid to the physical contents of the approximation methods. general method is given for improving the approximations.

539.1.07

313 CRYSTAL CdS GAMMA-RAY [PHOTOCONDUCTIVE] DETECTORS. I.D.Konozenko and V.I.Ust'yanov.
iz. tverdogo Tela, Vol. 1, No. 1, 89-94 (Jan., 1959). In Russian.

Preparation and mounting of CdS monocrystals, polycrystals nd mosaics, are described. The sensitivities of these detectors, easured in vacuo, varied from 10^{-4} to 10^{-2} μA per μr/sec (the ariations were due to structural and geometrical nonuniformities).
A.Tybulewicz

539.1.07

314 RADIOLUMINESCENT DOSIMETER. L.Mallet and H.Constans.
C.R. Acad. Sci. (Paris), Vol. 249, No. 10, 953-5 (Sept. 7, 1959). In French.

The apparatus described is based on the luminescence effect produced by high-energy radiations in transparent organic media, a 10-stage photomultiplier of time response 2×10^{-8} sec being used to detect the luminescence. The dosimeter can be employed over a wide range of activity, from a few microcuries up to several hundred curies, and is specially intended for use in radiobiological research and in γ-radiation intensity measurements in living tissues or in equivalent media. Its reliability and speed are much superior to those of a Geiger counter.

539.1.07

315 A LIQUID HELIUM BUBBLE CHAMBER. W.M.Fairbank, J.Leitner, M.M.Block and E.M.Harth.
Bull. Inst. Internat. Froid, Annexe 1958 - 1, 45-54.

A liquid helium bubble chamber, having a useful volume of about 21.5 × 12.5 × 10 cm has been built at Duke University and successfully operated at the Berkeley bevatron. The chamber is placed in a magnetic field of 14.6 kG and expands every 6 sec. The expansion is controlled by a pneumatically operated piston. Total losses amount to 0.5 litre/hr. The thermal insulation is supplied by screens of heat-absorbing Solex glass, kept at temperatures intermediate between chamber and room temperature. To obtain the best conditions for bubble counting, the chamber is operated at a pressure of 300 mm. Details of construction are illustrated, some optical problems are discussed and a photograph of a beam of K^- mesons is given.
G.Martelli

539.1.07

316 HEAVY-LIQUID BUBBLE CHAMBERS. R.W.Williams.
Canad. J. Phys., Vol. 37, No. 10, 1085-99 (Oct., 1959).

Experience with some high-Z liquids or fluid mixtures in bubble chambers, at M.I.T. and from other groups, is discussed. Measurement procedures are analysed, and optimum methods are presented for angle measurements, pβc determination from multiple scattering, and momentum determination from magnetic curvature. Magnetic fields will be useful even in strongly scattering liquids. Combined use of magnetic and scattering determination is not much better than one alone. Results are presented on detection efficiency for high-energy gamma rays, and on the severe effects of radiation straggling on energy measurements on electron pairs.

539.1.07 : 621.374.32

317 A SIMPLE SINGLE-CHANNEL PULSE HEIGHT ANALYSER FOR MEDICAL MEASUREMENTS.

F.Hawliczek.
Atomkernenergie, Vol. 4, No. 7-8, 328-31 (July-Aug., 1959). In German.

A simplified single channel analyser is described which is suitable for moderate counting rates (10^3 pulses/sec), e.g. from a scintillation counter. The circuit consists of a ring-of-three amplifire, two discriminators for channel selection, and an anti-coincidence circuit. Full circuit details are given. The main application of the equipment would be diagnostic work using radio-active isotopes. T.Mulvey

539.1.07

318 MATTERS PERTAINING TO ELIMINATION OF BACKGROUND IN LOW ENERGY NUCLEAR PHYSICS MEASUREMENTS, WITH SPECIAL REFERENCE TO THE BARTOL O.N.R. GENERATOR. C.P.Swann, V.K.Rasmussen and H.O.Albrecht.
J. Franklin Inst., Vol. 268, No. 3, 226-34 (Sept., 1959).

A new low-background target room has been constructed for the Bartol-ONR Van de Graaff generator. This room is constructed of low-radioactivity-content concrete and serves to shield the target area from the radiation arising from the soil, the beam analysing magnet, and the small Bartol generator. Over the energy range from 400keV to 3 MeV, the natural radioactive background is at least a factor of 5 lower than in the original target room. The effects of neutrons from the analysing magnets and the small machine have been reduced to a negligible amount. The cost of the special concrete used in this structure was less than twice the cost of normal concrete.

539.1.07

319 THE POSSIBILITY OF DISTINGUISHING THE MASSES OF RELATIVISTIC CHARGED PARTICLES WITH THE HELP OF TRAVELLING WAVES IN A WAVEGUIDE. D.V.Volkov.
Zh. tekh. Fiz., Vol. 29, No. 2, 414-16 (March, 1959). In Russian.

The method proposed is most conveniently used to distinguish between the secondary heavy particles produced by primary beams of particles which are themselves produced in well-defined short bunches, such as the output from an electron linear accelerator. The secondary particles of interest are then all produced close to the same known phase of the accelerator r.f. field. Particles of a particular momentum are first sorted out by deflection in a fixed magnetic field. These particles are then allowed to pass along a waveguide carrying in the same direction a travelling wave of the same frequency as the original accelerating wave, giving a strong transverse electric field (about 100 kV/cm). The phase of this wave is adjusted so that each bunch of mixed particles starts its path in the guide in the maximum transverse field. Particles of differing mass will have slightly different velocities. If the phase velocity of the guide wave is identical with the velocity of one particular particle, this will experience the same deflecting force along the whole length of the guide. Particles of other masses, however, will experience an alternating force giving a far smaller or even zero deflection. For example, with a guide length of 2.3 m, carrying a wave with phase-velocity exactly equal to the velocity of K-mesons of momentum 2 GeV/c, and with transverse field strength of 100 kV/cm, K-mesons themselves would be deflected enough to give a displacement of 10 cm a few meters beyond the end of the waveguide, while π-mesons entering at the same time would have zero displacement. The usual methods of adjustment of the phase velocity of the guided wave are summarized. J.H.Fremlin

NUCLEAR FIELD THEORY

539.11

320 FIELD THEORY COMMUTATORS. J.Schwinger.
Phys. Rev. Letters, Vol. 3, No. 6, 296-7 (Sept. 15, 1959).

This discusses paradoxes in field theory, which arise from the contradictory requirements of the commutation relations and the nature of the energy spectrum. J.C.Taylor

539.11

321 THE TCP THEOREM AND ITS APPLICATION. G.Grawert, G.Luders, and H.Rollnik.
Fortschr. Phys., Vol. 7, No. 6, 291-328 (1959).

A review. The most general form of the P, T and C transformations are derived for free fields. The effect of interaction terms is considered. Alternatively, the passage to the general theory is made by considering the transformation of the asymptotic fields. The TCP theorem is proved by Pauli's method, but a sketch of Jost's proof is also given. Applications are made to the decay of charge-conjugate particles. There are appendices on anti-unitary operators and on representations of the Lorentz group. J.C.Taylor

539.11

322 DELBRÜCK SCATTERING BY A HOMOGENEOUS MAGNETIC FIELD. L.Hanke.
Acta phys. Austriaca, Vol. 12, No. 4, 472-4 (1959). In German.

The Green function (Abstr. 6520 of 1959) is applied to photon scattering in a uniform field. It is shown that, to a first approximation, no scattering occurs. R.A.Newing

539.11

323 STRUCTURE THEOREM FOR THE PHOTON PROPAGATOR. H.M.Fried.
Phys. Rev., Vol. 115, No. 1, 220-2 (July 1, 1959).

A simple theorem relating the structure of the bare and dressed photon commutators and propagators is derived, and its implication, with respect to the choice of photon gauge, is discussed.

539.11

324 THE RENORMALIZATION OF DIRAC–MAXWELL EQUATIONS. P.Sen.
Nuovo Cimento, Vol. 13, No. 6, 1122-32 (Sept. 16, 1959).

A previous hypothesis, that the free energy projection of the interaction term of the Dirac–Maxwell equations combines with the bare electron to form the true experimental electron and that such reformulated Dirac–Maxwell equations in terms of the experimental electron are already renormalized, is shown to be true by constructing an explicit analytic representation for the free energy operator, but it is found that a convergent quantum electrodynamics is a necessary prerequisite for its validity. Such quantum electrodynamics can be constructed with the help of the Feynman cut off or with a non-local interaction term in which the structure of the Dirac–Maxwell equations is maintained. The additional result that the charge renormalization is unity is obtained.

539.11

325 A TABLE OF "HARD CORE INTEGRALS" $\int_a^\infty \frac{e^{-ax}(1-e^{-x})^p}{x^{q+\frac{1}{2}}(x+x_0)^r}dx$ FOR CENTRAL POTENTIALS.

K.V.Laurikainen.
Ann. Univ. Turku AI, No. 32, 46 pp. (1959).

This table, together with one already published (Abstr. 5293 of 1959) may be used to solve the deuteron eigenvalue problem for a Yukawa potential with a hard core. There is an explanatory preface. R.J.N.Phillips

539.11

326 ELEMENTARY PARTICLE INTERACTIONS. P.Merat.
C.R. Acad. Sci. (Paris), Vol. 249, No. 5, 640-1 (Aug. 3, 1959). In French.

It is proposed to classify all particles according to their "charges" with respect to the electromagnetic, π- and K-mesic fields, and a certain new field. In the scheme suggested, Σ and Λ hyperons have no π-mesic charge. R.J.N.Phillips

539.11

327 SOME REMARKS ON THE CALCULATION OF THE POLARIZATION EFFECTS. I.
M.Carrassi and G.Passatore.
Nuovo Cimento, Vol.13, No.5, 944-55 (Sept. 1, 1959).

It is argued that in general the simplest approach to polarization calculations is to evaluate first the transition amplitudes between basic spin states. The rules for combining these amplitudes are discussed, and Compton scattering is treated for an example. R.J.N.Phillips

539.11

328 THE CONSERVED AMPLITUDES FOR SPIN-$\frac{1}{2}$ PARTICLES OF ZERO MASS. J.Winogradzki.
C.R.Acad. Sci.(Paris), Vol. 249, No. 13, 1087-9 (Sept. 28, 1959). In French.

Conservation laws associated with the zero mass Dirac equation are discussed. R.J.N.Phillips

539.11

329 THE GRAVITATIONAL ZERO MASS LIMIT OF SPIN-2 PARTICLES. O.Brulin and S.Hjalmars.

rk. Fys., Vol. 16, Paper 3, 19-32 (1959).

A relativistic equation for spin-2 particles is discussed, which educes in the zero mass limit to the linearized Einstein equations r the gravitational field in empty space. R.J.N.Phillips

539.11

330 INTERFERENCE EFFECTS IN LEPTONIC DECAYS. S.Weinberg.

hys. Rev., Vol. 115, No. 2, 481-4 (July 15, 1959).

It is proved that in any leptonic decay experiment in which the pton masses and charges may be neglected, and in which no seudoscalar correlations are measured, all V · A interference rms will be antisymmetric under exchange of the two leptons, hile the pure V and A terms will be symmetric. If the experiment easures a pseudoscalar correlation, these conclusions are eversed. Even if the lepton masses cannot be ignored (e.g. for $n \rightarrow \mu^- + \bar{\nu} + p$, or low-energy β decay) it is still true that no V · A terference may appear when scalars are measured, and only V · A terference may contribute when pseudoscalars are measured, ovided that the lepton spins and momenta are not directly served. Thus experiments can be devised that involve no inter- rence effects, or only interference effects. This theorem holds dependently of the strangeness change, spin change, energy transfer, of any particular assumptions about the form of the V and A rrents. It proves most useful when it is difficult or tedious to lculate transition rates directly. Applications are discussed, cluding possible tests of the Feynman–Gell-Mann theory in non- ique forbidden β decay, of the nature of the leptonic Λ^0 and K^0 ecay interaction, and of the charge symmetry properties of weak teractions.

539.11 : 539.12

331 GREEN'S FUNCTION APPROXIMATION METHOD. I. THE NUCLEON. D.S.Falk.

hys. Rev., Vol. 115, No. 4, 1069-73 (Aug. 15, 1959).

A method for the approximate construction of the nucleon reen's function is presented. The development is such that the pproximate Green's function automatically has the same analytical roperties as the exact one. This method involves the symmetrical reatment of the Green's function and, ultimately, the assumption that ertain particles behave in an uncorrelated manner. The approxi- ation results in a linear integral equation for the Green's function hich is completely renormalized. This equation is solved exactly arough the use of the spectral representation which, by construction, s consistent with the approximation.

539.11 : 539.2

332 GREEN'S FUNCTION APPROXIMATION METHOD. II. THE POLARON. D.S.Falk.

hys. Rev., Vol. 115, No. 4, 1074-78 (Aug. 15, 1959).

A method derived in Pt I for the approximate construction of ne nucleon Green's function is applied to that of the polaron. After naking an arbitrary translation of the phonon variables, a linear ntegral equation for the Green's function is derived by means of a ymmetrical treatment and a noncorrelation assumption, in complete nalogy to the nucleon problem. This equation is solved through the ntroduction of a spectral representation in the special case of zero otal momentum. The lowest energy state of the system is calculated n terms of the arbitrary translations and then minimized with espect to them. Using the simplest nontrivial cutoff procedure to btain the variational equation and its solution, results are obtained or values of the coupling parameter $\alpha \leq 3$, and are compared with hose of Feynman.

539.11 : 539.12

333 RELATIVISTIC THEORY OF UNSTABLE PARTICLES. II. P.T.Matthews and A.Salam.

Phys. Rev., Vol. 115, No. 4, 1079-84 (Aug. 15, 1959).

Continuation of Pt I (Abstr. 1070 of 1959), where an attempt was made to set up a field-theoretic foundation for the theory of mean mass and lifetime of an unstable particle. It was argued in Pt I that the decay-time plot of a beam of unstable particles is a concept peculiar to a single-particle theory; that from a field-theoretic point of view, mass (the variable conjugate to proper time) rather than time has the primary significance. Here it is shown that the spectral function $\rho(m^2)$ appearing in the (field-theoretic) one- particle propagator has a direct significance as the probability of finding in production an unstable particle of mass m. This allows us to define a "one-particle" state for the unstable particle as a superposition of its outgoing decay states suitably weighted in mass space [with a factor which is the square-root of $\rho(m^2)$]. The proper-time propagation of this state gives the decay amplitude, and its modulus is ideally the experimentally observed decay-time plot. The time plot is explicitly evaluated for π decay. Insofar as the distribution of mass values for the π meson starts with the μ mass (assumed stable), the time plot is not merely the conventional decay exponential $e^{-\tau/\tau_0}$. There are additional terms which become important about a hundred lifetimes after the particle is created. Finally we compare the time plots for particle and antiparticle decays on the basis of CTP invariance.

539.11

334 ON THE MOMENT OF INERTIA OF A MANY-PARTICLE SYSTEM. I. Yu.K.Khokhlov.

Zh. eksper. teor. Fiz., Vol. 36, No. 1, 295-9 (1959). In Russian.

The problem of determination of the moment of inertia is considered. The simplest consequence of the formula obtained is that the moment of inertia does not vanish and is not very small (as compared with the moment of inertia of a solid body) even in the case of a spherically symmetrical system.

539.11

335 MOMENT OF INERTIA OF INTERACTING MANY-BODY FERMION SYSTEMS. R.D.Amado and K.A.Brueckner.

Phys. Rev., Vol. 115, No. 4, 778-84 (Aug. 15, 1959).

It is shown that the moment of inertia of a noninteracting many-body fermion system moving under periodic boundary conditions has the classical or rigid value when calculated on the "cranking" model of Inglis. By investigating the analogous "pushing" case for the inertial mass it is shown that the rigid moment can be associated with rigid rotation in spite of apparent surface currents. The effect of particle–particle forces is investigated in the lowest order of perturbation theory. The terms corresponding to a level shift or effective mass are just compensated by other terms and there is no change in the moment of inertia. The possible general validity of these results and their consequence is discussed.

539.11

336 DERIVATION OF A STRONG-COUPLING APPROXIMATION IN THE CHEW–LOW FORMALISM. H.Jahn.

Z. Phys., Vol. 156, No. 4, 633-56 (1959). In German.

A strong-coupling approximation method for the Chew–Low meson–nucleon scattering formalism is developed, considering, for simplicity, the case of charged scalar mesons. As a starting point, the Low equation formulated for the case of strong coupling is stated. This formulation explicitly takes into account the formation of excited compound-nucleon states which arise in the case of strong coupling. The data concerning the zero-meson part and the compound-nucleon excitation energies, necessary to specify this Low equation, are introduced approximately by means of the field-splitting transformation previously developed. The one-meson approximation is constructed; this corresponds to a certain kind of many-meson approximation of the usual Low equation whose limit as $g \rightarrow \infty$ holds exactly. It is hoped that these considerations will serve to guide an analogous investigation using the pseudoscalar theory.

539.11

337 SCATTERING INTEGRAL EQUATIONS IN HILBERT SPACE. A.G.Tixaire.

Helv. Phys. Acta, Vol. 32, No. 5, 412-22 (1959).

Extends the theory given by Jauch for multichannel scattering systems (Abstr. 6526-7 of 1959). Several integral representations of the Möller operators are obtained, which are related to three integration methods: Riemann, Cauchy and Riemann–Stieltjès integrals of operator-valued functions. Three types of integral equation are derived for the ingoing and outgoing waves within Hilbert space. Their validity range is studied and reasonable conditions are given of the channel interaction Hamiltonians in order to justify them. The present results apply to a wide class of "switching factors". The Lippmann–Schwinger equations appear as formal solutions of the author's RS-integral equations outside Hilbert space.

539.11

338 A COVARIANT STUDY OF HIGH ENERGY NUCLEON–NUCLEON SCATTERING. M.Gourdin.

Ann. Phys. (Paris), Ser. 13, Vol. 4, No. 5-6, 595-641 (May-June, 1959). In French.

PA3

A partial wave treatment of the Bethe–Salpeter equation with arbitrary kernel is developed, subject to some approximations. For pseudoscalar meson theory in the ladder approximation, with coupling constant $g^2/4\pi = 20$, the $^1S_0$ phase-shift fits the low-energy parameters and is qualitatively correct at higher energy.

R.J.N.Phillips

539.11

339 MODIFIED MESON PROPAGATION FUNCTION IN PSEUDO-VECTOR COUPLING THEORY. Ning Hu.

Science Record (China), Vol. 3, No. 9, 408-12 (Sept., 1959).

The poles of this function (obtained by summing a subset of perturbation theory terms which is a geometrical progression) are shown to lie on the real axis for all sufficiently large coupling constants.

J.C.Taylor

539.11

340 RE-ARRANGEMENT COLLISION MATRIX. G.Mohan.

Nuovo Cimento, Vol. 13, No. 6, 1065-73 (Sept. 16, 1959).

A study of the rearrangement collision matrix, under certain asymptotic assumptions is made. It is found that although the "asymptotic states" are non-orthogonal, by a proper choice an orthogonal and complete set of physical states with prescribed asymptotic properties can be constructed. Identity of different expressions of the collision matrix is re-derived. Finally, by the help of the collision matrix the state vector itself is expressed in a form where the incoming and outgoing waves into various channels are explicitly separated without putting any configuration space restrictions.

ELEMENTARY PARTICLES

539.12

341 CAPTURE, BETA DECAY, AND PI-MESON DECAY. M.L.Goldberger.

Rev. mod. Phys., Vol. 31, No. 3, 797-801 (July, 1959).

The structure of the matrix-elements for these processes is analysed using dispersion techniques (spectral representations). The principal results are : (a) the demonstration of an effective pseudoscalar coupling in μ-capture;(b) an estimate of "weak magnetism";and (c) an explanation of the π-decay lifetime on the assumption that transitions via nucleon-antinucleon pairs are of greatest importance.

P.K.Kabir

539.12

342 ON A RELATION BETWEEN SCATTERING AND PRODUCTION AMPLITUDES. J.Sucher and T.B.Day.

Nuovo Cimento, Vol. 13, No. 6, 1111-16 (Sept. 16, 1959).

An integral equation is derived which exhibits directly the relation between an amplitude for production, including all interactions, and the corresponding amplitude for complete scattering between the initial particles alone, and between the final particles alone. The only non-measurable quantity involved in this relatively simple relation is shown to be an amplitude for "pure production" in which intermediate states with either the initial particles or the final particles are excluded.

Photons

539.12

343 GENERALIZED CURRENT CONSERVATION AND LOW ENERGY LIMIT OF PHOTON INTERACTIONS. E.Kazes.

Nuovo Cimento, Vol. 13, No. 6, 1226-39 (Sept. 16, 1959).

If the fields that describe a system are renormalizable their interaction with low energy photons in the first two orders in the frequency is shown to be given by the "static" properties of the system. This is shown to essentially follow from current conservation. Compton scattering, bremsstrahlung and photo-pion production are examined. In the latter case, although the result is gauge invariant in the first two orders in the frequency, there is no certainty of obtaining all terms of this order. The missing terms probably arise from Feynman diagrams in which the photon is connected to a part containing no charged links to the rest.

539.12

344 EVIDENCE OF THE SCATTERING OF 2.62 MeV PHOTONS BY THE ELECTRIC FIELD OF NUCLEI. (DELBRÜCK EFFECT).

L.Goldzahl, P.Eberhard, H.Cornille and M.Chapdelaine.

C.R. Acad. Sci. (Paris), Vol. 249, No. 3, 401-3 (July 20, 1959). In French.

The existence of the Delbrück effect is demonstrated by comparing the measured coherent scattering of 2.62 MeV γ-rays by lead, bismuth and uranium, with that expected from the Rayleigh and Thomson effects.

J.D.Dowell

539.12

345 NOTES ON COHERENT BREMSSTRAHLUNG. O.R.Frisch.

Acta phys. Austriaca, Vol. 12, No. 4, 331-5 (1959). In German.

The results of Dyson and Überall (Abstr. 8833 of 1955) on the coherent superposition of bremsstrahlung amplitudes for radiation initiated in crystals are deduced from simple semi-quantitative physical arguments.

P.Roman

539.12

346 BREMSSTRAHLUNG CROSS-SECTION FORMULAS AND RELATED DATA. H.W.Koch and J.W.Motz.

Rev. mod. Phys. Vol. 31, No. 4, 920-55 (Oct. 1959).

Theoretical formulae and related data are given in a form convenient for practical calculations. For some cases comparisons are made with experimental results and the accuracy of the formulae estimated.

C.J.Batty

X-rays

539.12

347 SMEKAL–RAMAN TYPE MODIFIED X-RAY SCATTERING. K.Das Gupta.

Phys. Rev. Letters, Vol. 3, No. 1, 38-40 (July 1, 1959).

CuKα, CuKβ, MoKα and MoKβ radiations were scattered from carbon and beryllium and analysed by means of a curved-crystal spectrometer: the spectra showed weak Smekal–Raman scattering (due to electronic transitions) as well as Compton and unmodified scattering.

A.R.Stokes

539.12

348 A NEW ELECTRODE SYSTEM FOR AN X-RAY TUBE WITH A FINELY FOCUSED SPOT.

R. Hosemann and J. Hoeft.

Z. angew. Phys., Vol. 11, No. 9, 365-7 (Sept., 1959). In German.

Describes a sealed-off X-ray tube with a spot size of 30μ half-width. An electrostatic double lens system is employed. The cathode is in the form of a plane spiral.

A. E. I. Research Laboratory

539.12 : 778.3

349 X-RAY DOSIMETRY AND CONTACT MICRORADIOGRAPHY WITH COLOR FILM.

G.L.Clark and R.M.Uznanski.

Science, Vol. 130, 390 (Aug. 14, 1959).

The effect of X-rays at various voltages and intensities, with monochromatic and polychromatic beams, on Ektachrome daylight and artificial-light film was investigated. The colours were rated according to the Munsell colour system and ranged over all the spectrum except red. The colour in terms of hue, value, saturation, and chroma was a function of wavelength as well as intensity, and thus the method may be useful in dosimetry as well as in radiography. Microradiographs of metals and wood were remarkable in showing detail not obtainable with conventional black-and-white photographic emulsions.

Electrons

539.12

350 INELASTIC ELECTRON–DEUTERON SCATTERING CROSS SECTIONS AT HIGH ENERGIES. L.Durand, III.

Phys. Rev., Vol. 115, No. 4, 1020-38 (Aug. 15, 1959).

The effects on the cross-sections for the inelastic electron–deuteron scattering process $e + d \rightarrow e + n + p$ of interactions between the outgoing nucleons are examined in detail. The cross-sections

re calculated in the first Born approximation with respect to the lectromagnetic interaction using nucleon wave-functions modified y the final state interactions. Crude estimates indicate that the eak value of the cross-section $d^2\sigma/(d\Omega_e dE_e')$ may be decreased by 5-10% in the presence of such interactions. It is shown that addi-onal decreases of ~5% will result when proper account is taken of ae D-state component of the deuteron wave-function. These changes the cross-section affect appreciably the determination of the eutron magnetic form factor from the experimental scattering cross-ections. A new method of measuring the magnetic form factor ased on the angular distribution of the outgoing nucleons is there-re proposed which eliminates almost all the uncertainties relating the deuteron wave-function and the effects of final state interactions. his method may also be used in conjunction with the dependence of ae cross-sections on the electron scattering angle to study the be-aviour of the neutron charge form factor in the region of large omentum transfers. The polarization of the outgoing nucleons is so calculated. While significant information may in principle be btained from polarization measurements, the required experiments o not appear to be feasible at the present time. The modifications the cross-sections resulting from relativistic effects are con-dered, and some uncertainties inherent in previous work are arified.

539.12

351 SCATTERING OF FAST ELECTRONS FROM THE DEUTERON. H.Zingl.

cta phys. Austriaca, Vol. 12, No. 4, 461-71 (1959). In German.

The potential used previously by Clementel and Villi (Abstr. 391 of 1957) for the electron–proton scattering problem is used ere for the deuteron. This potential consists of a Coulomb term nd a Yukawa term, the strength and range of which are determined rom recent experimental work. The Born approximation is used r the scattering, and as the two-nucleon system cannot be treated elativistically, the wave function of Schwinger and Rarita is used r the deuteron. It is found that the strength of the Yukawa term eeds to be greater than unity, implying a repulsive singularity in ne potential at the centre of the proton. The result of about 1.1 is mewhat smaller than the value of Clementel and Villi. The range s found to be 0.3 Fermi. The possibility of interpreting the results s a breakdown of quantum electrodynamics at small distances is lso discussed. J.A.Evans

539.12

352 THE RELATIVE STOPPING POWERS OF PURE GASES TO THAT OF AIR. N.A.Baily and G.C.Brown.

adiation Research, Vol. 11, No. 6, 745-53 (Dec., 1959).

A comparison between theoretical and experimental values of e relative stopping powers of pure gases for electrons has been esented. The experimental data were obtained by using the β-ray ectrum for thick sources of S^{35}, P^{32}, and Y^{90}. The gases studied ere: hydrogen, helium, nitrogen, oxygen, air, neon, argon, krypton, nd xenon. Values of the relative stopping powers for bone and uscle have been computed from the experimental data.

539.12

353 DEPOLARIZATION OF ELECTRONS DUE TO RADIATION IN A MAGNETIC FIELD.

u.F.Orlov and S.A.Kheifets.

h. eksper. teor. Fiz., Vol. 35, No. 2(8), 513-14 (Aug., 1958). In ussian. English translation in : Soviet Physics-JETP (New York), ol. 35(8), No. 2, 354 (Feb., 1959).

An order of magnitude calculation is made of the depolarization ue to radiation by polarized electrons rotating in a magnetic field. s magnitude is such as to be unimportant in a measurement of the agnetic moment of the electron with accuracy sufficient to include e second correction. A.Ashmore

539.12

354 ON THE DIRECT PRODUCTION OF AN ELECTRON PAIR BY A HIGH ENERGY α-PARTICLE.

.Lanius and H.W.Meier.

uovo Cimento, Vol. 13, No. 2, 444-5 (July 16, 1959).

Two minimum tracks, produced by a cosmic-ray α-particle of 2.32×10^3 TeV, have been observed in an emulsion stack (see .Ciok et al., Abstr. 1117 of 1957). Possible identifications of the acks are considered. A probability of 0.7 is obtained for the articles being an electron pair produced in the electric field of a ucleon in the emulsion, compared with probabilities of less than 10^{-4} for other processes. J.D.Dowell

539.12

355 IONIZATION ALONG THE TRACKS OF HIGH ENERGY ELECTRON–POSITRON PAIRS. A.A.Varfolomeev, R.I.Gerasimova, L.A.Makarina, A.S.Romantseva and S.A.Chueva.

Zh. eksper. teor. Fiz., Vol. 36, No. 3, 707-16 (1959). In Russian.

Experimental data are presented on the track densities of five high energy electron–positron pairs in nuclear emulsions. The measurements were performed for the first pairs of electron–photon showers. The pair energy was estimated from the energy spectrum of the cascade electrons at a distance of 2.5-3 radiation lengths from the vertex of the first pair. In three cases the pair energy was close to 10^{12} eV and in two cases approximately 3×10^{11} eV. The track density was determined by two methods – from the grain density in the track and from the gap length distribution coefficient. Compared with a particle for which the specific energy loss is twice as large as the ionization loss of the electron, the track density of the pair near the vertex was found to be smaller. This decrease of the pair track density can be explained by the mutual screening of the electron and positron during ionization. The results are compared with the theoretical ionization curves for pairs calculated by Chudakov [Izv. Akad. Nauk SSSR, Ser. Fiz., Vol. 19, 651 (1955)].

Nucleons

539.12

356 THE EFFECT OF THE STRUCTURE OF THE NUCLEON ON THE CAPTURE OF μ-MESON BY PROTON.

Y.B.Dai, T.H.Ho and H.Y.Tzu.

Scientia Sinica, Vol. 8, No. 8, 802-6 (Aug., 1959).

It is pointed out that, owing to the similarity existing between the electromagnetic interaction and the vector part of the weak interaction proposed by Feynman and Gell-Mann, the contribution of the vector part of the weak interaction to μ-capture by proton is closely related to the electromagnetic form factors of the nucleon. Formula for the capture probability calculated with the renormalized V–A weak interaction is given. The correction to the contribution of the vector part of the weak interaction due to the charge and magnetic moment distribution of the nucleon is estimated on the basis of the data of electron–nucleon scattering experiments.

539.12 : 539.11

APPROXIMATION METHOD FOR THE NUCLEON GREEN'S FUNCTION. See Abstr. 331

539.12

357 SEARCH FOR A METHOD OF CALCULATING THE ANOMALOUS MAGNETIC MOMENT OF THE NUCLEON. Y.Héno.

C.R. Acad. Sci. (Paris), Vol. 249, No. 16, 1469-70 (Oct. 19, 1959). In French.

The ratio of neutron and proton anomalous moments is given to second order in the meson–nucleon coupling, using a relativistic form factor at all vertices. The problem of gauge invariance is discussed. R.J.N.Phillips

539.12

358 ANOMALOUS MAGNETIC MOMENT OF THE NUCLEON. E.Yamada.

Suppl. Progr. theor. Phys., No. 5, 1-16 (1958).

Investigations on the anomalous magnetic moment of the nucleon are reviewed. It is suggested that there may be some possibilities of obtaining a rather satisfactory result with the modifications of Sachs' phenomenological analysis by the inclusion of effects of nucleon pairs and K-mesons. Although most of the calculations show too large contributions from the nucleon current, the effect of field reactions considerably improves the result of perturbational calculation. It is noted that there arises an ambiguity in defining the anomalous magnetic moment in the nonrelativistic calculation. The charge distribution around a nucleon is also discussed briefly.

539.12

359 PION THEORY OF THE ANOMALOUS MAGNETIC MOMENT OF THE NUCLEON. H.Hasegawa.

Suppl. Progr. theor. Phys., No. 5, 17-40 (1958).

This paper describes concretely the renormalization procedure proposed in the preceding abstract, and gives the methods of calculation and the basic results concerned. An

analysis of the anomalous magnetic moment of the electron is carried out, from which valuable suggestions are obtained for solving the problem of the anomalous magnetic moment of the nucleon. The effect of nucleon–antinucleon pairs is also studied in detail.

539.12

360 ELASTIC NUCLEON–DEUTERON SCATTERING IN A SOLUBLE MODEL AS A TEST OF THE IMPULSE APPROXIMATION. T.Fulton and P.Schwed.
Phys. Rev., Vol. 115, No. 4, 973-9 (Aug. 15, 1959).

A comparison of the results of the Born and impulse approximations for a well-defined situation is made by calculating the nucleon–deuteron differential elastic cross-sections in both approximations at incident nucleon laboratory energies of 32, 94 and 146 MeV In order to carry out the impulse approximation computation in complete detail, including, in particular, contributions from off-energy-shell two-particle matrix elements, the assumption is made that the two-particle scattering is completely described by effective range theory. This assumption, though incorrect, nevertheless retains some of the features of the actual physical situation and provides a means of comparing the results of calculations using the impulse approximation and the Born approximation as well as a way of studying the effect of including two-particle matrix elements off the energy shell. Exact solutions to the two-particle model are written down with the aid of the Gel'fand–Levitan theory and are used in a precise numerical evaluation of the impulse approximation expressions. The results of the Born and impulse approximations differ considerably. Also, indications are that, as expected, the pickup term (which dominates at large angles) is not adequately treated by either of the above approximations. When this term is not considered, a study of the remaining expressions shows that off-energy-shell effects are significant for the deuteron wave-functions employed. In view of the rather restrictive assumptions made on the two-particle data, a detailed comparison of the results with experiment is not possible. Nevertheless there is a suggestion that the impulse approximation, including off-energy-shell effects, describes the experimental results best.

Protons

539.12

361 $\bar{p}$–p CROSS SECTIONS FROM 534 TO 1068 MeV. T.Elioff, L.Agnew, O.Chamberlain, H.Steiner, C.Wiegand and T.Ypsilantis.
Phys. Rev. Letters, Vol. 3, No. 6, 285-8 (Sept. 15, 1959).

Details are given of the antiproton beam selection methods and of the counter system for recording and classifying interactions in a hydrogen target. Total, elastic, inelastic and charge exchange cross-sections were thus measured simultaneously. This was done for antiproton energies of 534, 700, 816, 948 and 1068 MeV. A check on the counter system was made by measuring proton–proton cross-sections at 528 and 940 MeV. In the energy range of the measurements the elastic scattering was about a third of the total cross-section. At 534 MeV about half the elastic scattering was peaked forward within a 14° lab. angle. The inelastic cross-section ratio is in agreement with the black sphere model with a radius of $\frac{2}{3}$ of the pion Compton wavelength. The constancy of the ratio as the energy increases suggests that the annihilation range may be longer than was expected. A.Ashmore

539.12

362 INTERACTIONS OF ANTIPROTONS IN NUCLEAR EMULSION. G.B.Chadwick and P.B.Jones.
Phil. Mag. (Eighth Ser.), Vol.3, 1189-91 (Oct., 1958).

The mean free path for absorption, charge exchange and inelastic scattering is found to be $21.0^{+2.8}_{-2.2}$ cm. The two elastic scattering events found agree with a cross-section of 41^{+10}_{-7} mb for the process. The π-meson energy spectrum for annihilations at rest suggests the presence of a high energy group at ~400-500 MeV. S.J.St-Lorant

Neutrons

539.12

363 STATISTICAL TIME MOMENTS AND AN ASYMPTOTIC FORMULA FOR THE TIME–ENERGY DISTRIBUTION OF SLOWED-DOWN NEUTRONS. K.E.Eriksson.
Ark. Fys., Vol. 16, Paper 1, 1-14 (1959).

Starting with the exact solution to the problem of slowing-down of neutrons by elastic collisions against free atoms at rest, which was derived by Waller (1959) the exact time moments and the conditions for their existence are obtained. Waller has derived the exact positive moments. The present treatment is somewhat different because it was wished to get an analogue treatment of positive and negative moments. Assuming small energies, the approximate formul of von Dardel (1953) and Walen (1952) for the negative moments are also obtained. Starting from Waller's solution an asymptotic formula is derived which can be directly compared with those derived by Marshak (1947) and von Dardel by means of the method of moments. Although these formulae are rather good approximations in the region, where the distribution function is large, they are correct only to the first order if expanded in powers of 1/x. In a diagram are given the results of numerical calculations for deuterium and carbon moderators based on a formula first derived by Svartholm (1955). As Waller has shown, this formula follows, in a natural way, from the general solution, and it appears to give, for any finite time, the correct asymptotic distribution function for neutrons energies, much smaller than the initial energy. In another diagram are compared von Dardel's distribution function and the above asymptotic function with Svartholm's function. Von Dardel's function is here seen to be a fairly good approximation in the experimentally most interesting region. The second, non-vanishing term of the expansion obtained for the distribution function by Olsson (1955) is also calculated in the form a power series in time. In order to estimate the rate of convergence this term is then compared with the first non-vanishing term, which has been calculated by Olsson. Finally, the time distribution functions for different energies are discussed.

Mesons

539.12

364 SEARCH FOR THE REACTION $\mu^+ + e^- \rightarrow \gamma + \gamma$. C.M.York, C.O.Kim and W.Kernan.
Phys. Rev. Letters, Vol. 3, No. 6, 288-91 (Sept. 15, 1959).

The μ^+-mesons were produced from a π^+-meson beam brought to rest in a copper target and viewed by an array of scintillation counters. Only one possible event was detected, giving the rate of the reaction less than 2.5 ± 0.4 sec^{-1}. C.J.Batty

539.12

365 APPLICATIONS OF THE WEIZSÄCKER–WILLIAMS METHOD TO MUON INELASTIC SCATTERING. P.Kessler.
C.R. Acad. Sci. (Paris), Vol. 249, No. 16, 1471-3 (Oct. 19, 1959). In French.

Estimates various high-energy inelastic processes. Concludes that they will not seriously impede the measurement of elastic scattering from nuclei. R.J.N.Phillips

539.12 : 532.7

NEUTRON SCATTERING STUDY OF DIFFUSIVE MOTIONS IN LIQUIDS. See Abstr. 79. 80

539.12

366 THEORY OF MUON CAPTURE. H.Primakoff.
Rev. mod. Phys., Vol. 31, No. 3, 802-22 (July, 1959).

An exhaustive treatment of the subject including parity non-conservation effects, and comparison with experimental results. P.K.Kabir

539.12

367 THE ELECTRON DECAY MODE OF THE PION. J.Ashkin, T.Fazzini, G.Fidecaro, A.W.Merrison, H.Paul and A.V.Tollestrup.
Nuovo Cimento, Vol. 13, No. 6, 1240-62 (Sept. 16, 1959).

This paper presents evidence for the existence of the electron decay mode of the pion. The branching ratio found for this mode, compared with the normal muon decay, is $(1.22 \pm 0.30) \times 10^{-4}$. This is in good agreement with the V–A theory of weak interactions.

539.12

368 EXPERIMENT ON CHARGE INDEPENDENCE IN PION INTERACTIONS. D.Harting, J.C.Kluyver, A.Kusumegi, R.Rigopoulos, A.M.Sachs, G.Tibell, G.Vanderhaeghe and G.Weber.
Phys. Rev. Letters, Vol. 3, No. 1, 52-4 (July 1, 1959).

If charge independence in pion–nucleon interactions is a correct assumption, then the differential cross-sections for the

rocesses $p + d \rightarrow H^3 + \pi^+$, and $p + d \rightarrow He^3 + \pi^0$, should be in the atio 2 : 1 at all angles, except for corrections due to mass differnces and Coulomb effects. These corrections have been estimated increase the ratio by about 4%. The authors obtained a value .26 ± 0.11 in an experiment at 11.3° to a 600 MeV proton beam.
S.J.Goldsack

539.12

369 PHENOMENOLOGICAL THEORY OF PION–NUCLEON REACTIONS. S.Hayakawa, M.Kawaguchi and S.Minami.
ppl. Progr. theor. Phys., No. 5, 41-64 (1958).

A considerable contribution to the interpretation of pion–nucleon eactions can be made independently of the details of meson field eory. The present paper discusses this contribution, separating t the dynamical effects of pion–nucleon interactions. A historical rvey on this method of approach is given for the purpose of eluciting trends of activating in Japan. Both the angular distributions pions and the polarizations of recoil nucleons are calculated for on–nucleon scattering and photo-pion production. Relations beeen the above two reactions are investigated using the unitarity the S-matrix. Possible violations of charge independence expected low energies are discussed. Although the effects of charge dependnt interactions are small, except for the Coulomb interference, the timates given may facilitate the analysis of more accurate experients.

539.12

370 PION–HYPERON SCATTERING. INFLUENCE OF NON-SYMMETRIC Λ AND Σ INTERACTION.
Amati, A.Stanghellini and B.Vitale.
uovo Cimento, Vol 13, No. 6, 1143-55 (Sept. 16, 1959).

A field theoretical model is developed in order to study the low-ergy pion scattering on Λ or Σ hyperons, taking into account the –Σ mass difference and possible inequality of the coupling constants. om the results it is possible to study the corrections to the predicon of a theory in which Λ and Σ are considered degenerate with spect to pion interactions. These corrections are of the order of e hyperon mass difference over the pion energy and can shift the ssible resonances in an appreciable way. It is also briefly dissed which states can present resonances for particular choices the coupling constants. The relations of the previous results to e K^-–N absorption are discussed from a qualitative point of view.

539.12

371 THEORY OF THE HIGH-ENERGY PEAKS IN THE PION-NUCLEON CROSS SECTIONS.
en-Nong Wong and M. Ross.
hys. Rev. Letters, Vol. 3, No. 8, 398-400 (Oct. 15, 1959).

Attempts to explain the appearance of the peaks of 0.65, 0.95 ad 1.30 BeV in the π^-–p scattering and photoproduction spectra, in rms of low-energy pseudo-scalar π–N interaction. A Chew–Low rmalism is developed which predicts two isobars of the nucleon. hese could possibly be associated with the two high-energy peaks.
S.J.St-Lorant

539.12

372 DISPERSION RELATIONS FOR PRODUCTION OF π-MESONS. V.Tsellner.
okl. Akad. Nauk SSSR, Vol. 123, No. 5, 838-40 (Dec. 11, 1959). In ussian.

Following the works of Logunov and Tavkhelidze (Abstr. 6117 of 958; 3118 of 1959), dispersion relations are obtained for the proess $\pi + N \rightarrow 2\pi + N$ for two different spin and isospin states, under pn-spin-flip conditions.
P. Roman

539.12

373 PHOTOPRODUCTION OF NEUTRAL MESONS FROM HYDROGEN NEAR THRESHOLD.
.D.Luckey, L.S.Osborne and J.J.Russell.
hys. Rev. Letters, Vol. 3, No. 5, 240-2 (Sept. 1, 1959).

The differential cross-section for the reaction $\gamma + p \rightarrow p + \pi^0$ as measured for mean incident γ-ray energies of 170 and 190 MeV y determining the single π^0-decay γ-ray yields at 48°, 81° and 141° ab.). The results are compared with theoretical predictions.
C.J.Batty

539.12 : 539.11

RELATIVISTIC THEORY OF π-MESON DECAY. See Abstr. 333

539.12

374 POSSIBLE EVIDENCE FOR A NEGATIVE HEAVY MESON. T.Yamanouchi and M.F.Kaplon
Phys. Rev. Letters, Vol. 3, No. 6, 283-4 (Sept. 15, 1959).

Describes an emulsion event found in a stack exposed to a 300 MeV/c K^- beam. The incident particle gave rise to a star with a total of 8 prongs. One of these was a Σ^+ particle whilst another was possibly a helium hyperfragment. In this case the incident particle must have had a strangeness of −2; its mass is estimated to be approximately 650 MeV.
C.J.Batty

539.12

375 NOTE ON ANOMALOUS K^+-DECAY EVENTS. K.Hiida.
Nuovo Cimento, Vol. 13, No. 6, 1117-21 (Sept. 16, 1959).

The π^+-energy spectrum for the radiative θ^+-decay mode is calculated and it is shown that that π^+-energy spectrum has no peak at ~ 60 MeV. Therefore there is no strong evidence to assert that two anomalous K^+-decay events (with a π^--secondary of about 60 MeV) are due more probably to the radiative θ^+-decay mode than to a two body decay mode: $K^+ \rightarrow \pi^+ + X^0$, where X^0 is a neutral boson with a mass of (500 ± 5) times the electron mass.

539.12

376 LEPTONIC DECAY MODES OF K-MESONS AND HYPERONS. N.Cabibbo and R.Gatto.
Nuovo Cimento, Vol. 13, No. 6, 1086-110 (Sept. 16, 1959).

The decay modes $K \rightarrow \pi$ + charged lepton + ν and $Y \rightarrow N$ + charged lepton + ν are studied by dispersion relation methods. The final spectra for K_3 decays are derived from the solution of an integral equation for the decay amplitude. The methods of solutions for such equations are briefly reviewed.

539.12

377 LEPTONIC DECAY MODES OF THE K MESON. K.Chadan and S.Oneda.
Phys. Rev. Letters, Vol. 3, No. 6, 292-5 (Sept. 15, 1959).

The ratios of the rates of the decays $K \rightarrow \mu + \nu$, $K \rightarrow \pi + e + \nu$, $K \rightarrow 2\pi + e + \nu$ are estimated from dimensional arguments. A similar estimate is made of the ratio of the rates of $K \rightarrow 2\pi + e + \nu$ and $K \rightarrow 3\pi$. Comparing these two estimates, and using the known rates of $K \rightarrow \pi + e + \nu$ and $K \rightarrow 3\pi$, it is concluded that the results are consistent with the apparent slow β-decay of the Λ-particle.
J.C.Taylor

539.12

378 $K^+ - K^0$ MASS DIFFERENCE. P.T.Matthews and J.L.Uretsky.
Phys. Rev. Letters, Vol. 3, No. 6, 297-9 (Sept. 15, 1959).

The K^0 is not like the π^0 in having a zero charge density. It is therefore possible to construct a reasonable classical model of the K^0 and K^+ in which the neutral particle has the greater electrostatic energy. The classical model is related to an approximate quantum mechanical calculation.
J.C.Taylor

539.12

379 THE ENERGY DEPENDENCE OF LOW ENERGY K^-–PROTON PROCESSES. R.H.Dalitz and S.F.Tuan.
Ann. Phys. (New York), Vol. 8, No. 1, 100-18 (Sept., 1959).

Assuming the K^-–proton interaction to have negligible range, the energy-dependence of the cross-sections for elastic scattering, charge-exchange and reaction processes is discussed, taking into account the dominant effects of the $K^- - \bar{K}^0$ mass difference. The formulae obtained are used for the discussion of the cusps which appear at the K^-–p and $\bar{K}^0$–n energy thresholds and for the analytic continuation of the scattering amplitude into the unphysical region of negative K^-–p energies which is of relevance for the use of K-meson dispersion relations. Four sets of scattering amplitudes are obtained consistent with all the present data on K^-–proton interactions and the possibilities for discrimination between them are discussed. Two of these amplitudes are found to correspond to a resonance-like behaviour just within the unphysical region.

539.12

380 INELASTIC FINAL-STATE INTERACTIONS: K^- ABSORPTION IN DEUTERIUM. R.Karplus and L.S.Rodberg.
Phys. Rev., Vol. 115, No. 4, 1058-69 (Aug. 15, 1959).

In a reaction from which several strongly interacting particles emerge it is often possible to isolate the effects of forces between

two of the outgoing particles. There are many cases in which this final-state interaction can produce inelastic reactions. The formalism that describes this situation is developed here, and the reaction $K^- + d \rightarrow \pi + \Sigma + N \rightarrow \pi + \Lambda + N'$ is studied in detail as an example. It is found that large Λ/Σ branching ratios can result and can be used to restrict the Σ–N and K–N interaction parameters. The gross features of the spectrum can be understood using a simple model. It does not seem possible to determine the parities of the strange particles from the momentum spectra. When the inelastic reaction in the final state is exothermic, as in the example, high partial waves may contribute.

539.12

381 NUCLEAR INTERACTION OF θ_2 MESONS IN EMULSION.
U.Camerini, W.F.Fry, M.Baldo-Ceolin, H.Huzita and S.Natali.
Phys. Rev., Vol. 115, No. 4, 1048-52 (Aug. 15, 1959).

For previous work, see Baldo-Ceolin et al., Abstr. 8882 of 1957. Additional observations in emulsion on the nuclear interaction of neutral K mesons are reported. A total of 1 τ^+, 7 K^-, 7 Σ^+, 10 Σ^-, and 18 hyperfragments were observed. The relative frequencies of different types of strange particles produced in the emulsion are consistent with the assumption that the neutral K-meson is a particle admixture and that interactions in the θ and $\bar{\theta}$ modes are similar to interactions of K^+ and K^-, respectively.

539.12

382 PHOTOPRODUCTION OF K^+ MESONS.
B.D.McDaniel, A.Silverman, R.R.Wilson and G.Cortellessa.
Phys. Rev., Vol. 115, No. 4, 1039-48 (Aug. 15, 1959).

The photoproduction in hydrogen of K^+ mesons in association with hyperons was studied using an 1160 MeV bremsstrahlung beam from the Cornell synchrotron. The K-mesons were selected with a magnetic analyser and counter telescope system. They were further identified by bringing them to rest in a stopping block and by the detection of the particles arising from their decay. The angular distribution for the associated production of K^+-mesons with Λ^0-hyperons at the photon energies of 980 and 1010 MeV was studied. Measurements were also made of the cross-section as a function of photon energy for the centre-of-mass angle of 85°. The results of these measurements are compatible with S-wave production. The photoproduction of Σ^0-hyperons in association with K^+-mesons was also measured for one set of kinematical conditions. The measured $(K^+ - \Sigma^0)$ cross-section is comparable to that of the $(K^+ - \Lambda^0)$ process.

Hyperons

539.12

383 PARITY CONSERVATION IN HYPERON PRODUCTION BY 1.15-BeV/c K^- MESONS ON PROPANE.
R.L.Lander, W.M.Powell and H.S.White.
Phys. Rev. Letters, Vol. 3, No. 5, 236-7 (Sept. 1, 1959).

Investigation of 110 Λ^0 decays produced by a 1.15 BeV/c K^- beam in a 30 in. propane bubble chamber. The angular distribution of decay pions from the Λ^0 in the Λ^0 rest frame is consistent with an isotropic distribution, indicating that the longitudinal component of polarization is zero and that parity is conserved in the production interaction. C.J.Batty

539.12

384 SIGMA SPIN AND PARITY CONSERVATION IN $K^- + p \rightarrow \Sigma^+ + \pi^-$. J.Leitner, P.Nordin, Jr, A.H.Rosenfeld, F.T.Solmitz and R.D.Tripp.
Phys. Rev. Letters, Vol. 3, No. 5, 238-9 (Sept. 1, 1959).

Investigation of the decay properties of 145 Σ^+ hyperons produced by the capture of K^--mesons in liquid hydrogen. Strong evidence is found from the angular distribution of decay pions that the Σ spin is $\frac{1}{2}$. Parity is found to be conserved in the reaction $K^- + p \rightarrow \Sigma^+ + \pi^-$. C.J.Batty

539.12

385 POSSIBILITY OF STUDYING THE Λ-HYPERON–NUCLEON FORCE BY LOW-ENERGY SCATTERING.
C.G.Gardner and T.A.Welton.
Phys. Rev. Letters, Vol. 3, No. 6, 281-3 (Sept. 15, 1959).

It is shown that a measurement of the depolarization occurring when polarized Λ-hyperons of less than 30 MeV energy are scattered off protons is likely to yield useful information on the relative strengths of singlet and triplet s-state Λ–nucleon potential. Some suggestions of how the experiment might be performed are discussed. E.J.Squires

Strange particles

539.12

386 STRANGE PARTICLE DECAY PROCESSES AND THE FERMI INTERACTION. R.H.Dalitz.
Rev. mod. Phys., Vol. 31, No. 3, 823-33 (July, 1959).

A theoretical discussion of the leptonic and non-leptonic decays of strange particles including hyperons on the basis of four-fermion couplings. P.K.Kabir

Tritons

539.12

387 MAGNETIC MOMENT OF THE TRITON IN UNITS OF THE MAGNETIC MOMENT OF THE PROTON.
W.Duffy, Jr.
Phys. Rev., Vol. 115, No. 4, 1012-14 (Aug. 15, 1959).

High-resolution nuclear magnetic resonance techniques were used to perform a precise measurement of the ratio of the Larmor frequencies of tritons and protons in a sample of 20% tritiated water. The measured ratio ω_T/ω_H is 1.066 639 75(2). From this frequency ratio and an estimate of the magnetic shielding correction, a value of 1.066 639 86(11) is obtained for the moment of the triton in units of the proton moment. From this value and the h.f.s. measurement of Kusch (Abstr. 1487 of 1956), and of Prodell and Kusch (Abstr. 6471 of 1957), one obtains a h.f.s. anomaly of $(-5.62 \pm 0.13)10^{-6}$ for tritium. This observed anomaly is compared with the theoretical predictions of Adams (Abstr. 2926 of 1951). The longitudinal relaxation time T_1 of the protons and tritons in the sample was measured and found to be 1.02 ± 0.10 and 0.83 ± 0.10 sec, respectively.

COSMIC RAYS

(Nuclear reactions due to cosmic rays are included under Nuclear Reactions)

537.59

388 ORIGIN OF COSMIC RAYS.
S.Hayakawa, K.Ito and Y.Terashima.
Suppl. Progr. theor. Phys., No. 6, 1-92 (1958).

An attempt is made to present a systematic view on the origin of cosmic rays. On the basis of the composition of primary cosmic rays and the galactic radio emission, arguments are presented that the galactic cosmic rays are stored in the galactic halo of spherical shape for the mean lifetime of about 10^8 years. The local sources of cosmic rays consist of the following two kinds: one is supernovae, at which about 10^{-6} of ejected particles are accelerated to cosmic ray energy, and the other is supergiant and red giant stars at which the above ratio seems to be 10^{-5}–10^{-7}. The chemical composition of cosmic rays from the latter is equal to that of the interstellar matter, while the former sources are responsible for the overabundance of heavy nuclei in cosmic rays.

537.59

389 THE LATERAL AND THE ANGULAR STRUCTURE FUNCTIONS OF ELECTRON SHOWERS.
K.Kamata and J.Nishimura.
Suppl. Progr. theor. Phys., No. 6, 93-155 (1958).

Lateral and angular distribution functions of the electron showers are derived analytically with and without the Landau approximation, including ionization loss. Tables and the numerical results of these functions are presented, and their results are applied to the analysis of high-energy cosmic-ray phenomena. Relations between the present theories and others are discussed critically, and it is shown that the other theories can be regarded as special cases of the ones described.

537.59

390 SEARCH FOR 550m_e PARTICLES IN THE SEA-LEVEL COSMIC RADIATION. I.B.McDiarmid.

hys. Rev., Vol. 115, No. 4, 1016-19 (Aug. 15, 1959).

An attempt was made to observe a 550m_e particle in the sea-vel cosmic radiation. A counter arrangement biased against the etection of μ-mesons was used to select particles stopping in a ultiplate cloud chamber. From the mass spectrum of these articles, determined from ionization and range measurements, an pper limit of 0.02% was obtained for the intensity of 550m_e articles relative to μ-mesons stopping in the same range interval. similar upper limit was also obtained by a method independent of ass measurements for the particular case in which one of the decay roducts of a 550m_e particle is a π^0 meson.

537.59 : 523.75

391 THE PRODUCTION OF COSMIC RADIATION BY A SOLAR FLARE ON AUGUST 31, 1956. K.G.McCracken.

Nuovo Cimento, Vol. 13, No. 6, 1074-80 (Sept. 16, 1959).

It is shown that the neutron counting rates observed by three idely separated recorders increased by approximately two percent bout half an hour after the observation of an intense solar flare at 226 U.T. on August 31, 1956. The event, as observed at all three tations, exhibited the abrupt onset, and gradual recovery typical of olar flare effects. The time delay between the first visual sighting f the flare, and the earliest arrival of cosmic radiation at the earth as about 20 min. It is shown that the quantity of cosmic radiation hich arrived at the earth was two to three orders of magnitude less han the quantities which arrived during earlier flare effects. Con-ideration of the temporal dependence of the small flare effect uggest that only a small quantity of cosmic radiation was produced n the solar flare.

537.59 : 523.75

392 A CORRELATION BETWEEN THE EMISSION OF WHITE LIGHT AND COSMIC RADIATION BY A SOLAR FLARE. ..G.McCracken.

Nuovo Cimento, Vol. 13, No. 6, 1081-5 (Sept. 16, 1959).

It is pointed out that the majority of the solar flares which were bserved to produce increases in the terrestrial cosmic-ray intensity ere also observed in white light. This is interpreted as evidence hat it is only the most energetic flares which produce any appreci-ble quantity of cosmic radiation, and that the rarity of the cosmic-ay flare effect is, at least in part, due to the rarity of very energetic olar flares. Evidence is presented that suggest that cosmic radia-on produced in a flare on the east limb of the sun is unable to reach he earth.

537.59

393 INCREASE OF THE BAROMETRIC EFFECT WITH THE ENERGY OF EXTENSIVE AIR SHOWERS.).D.Krasil'nikov.

h. eksper. teor. Fiz., Vol. 35, No. 1(7), 295-6 (July, 1958). n Russian. English translation in: Soviet Physics—JETP (New York), ol. 35(8), No. 1, 203-4 (Jan., 1959).

Two series of observations of the time variations of extensive ir showers were conducted in Yakutsk (62°N, 129°E, 100 m above ea level). Statistical analysis of the variation of the mean daily umber of showers, correlated with variations in temperature and ressure, disclosed a marked increase in barometric coefficient ith increasing mean particle flux density in the showers. The ffect can be explained in terms of the theory proposed by Nikol'skii t al. (Abstr. 4512 of 1957). The mean primary energy was stimated as $\sim 10^{15}$ eV. J.W.Gardner

537.59

394 ON THE BAROMETRIC PRESSURE COEFFICIENT FOR COSMIC-RAY NEUTRONS. .A.Lockwood and A.R.Calawa.

atmos. terrest. Phys., Vol. 11, No. 1, 23-30 (1957).

From the cosmic-ray neutron intensity recorded at Mount ashington, N.H., during 1954-1955, an accurate determination has een made of the barometric pressure which best measures the verage air mass above this mountain, where high wind velocities re prevalent. The results indicate that the existing pitot tube sys-em for compensating for the pressure deficiency produced by the irflow over the mountain is reliable to an estimated standard devi-ation of ±0.03 in.Hg. It also appears that the barometric pressure orrection for the neutron intensity at any location is one of the argest sources of error in studying primary cosmic-ray intensity-me variations from the time variations of the neutron intensity deep ithin the atmosphere.

537.59

395 A STUDY OF TERRESTRIAL CORPUSCULAR RADIATION AND COSMIC RAYS BY THE FLIGHT OF A COSMIC ROCKET.

S.N.Vernov, A.E.Chudakov, P.V.Vakulov and Yu.I.Logachev.

Dokl. Akad. Nauk. SSSR, Vol. 125, No. 2, 304-7 (1959). In Russian.

Two geiger counters and two scintillation counters were installed in the rocket directed at the Moon on January 2nd, 1959. Both geiger counters and one scintillation counter were inside a 1 gm/cm^2 shell of aluminium; the second scintillation counter was only covered by 7μ of aluminium. The results given are of preliminary data for distances of 8-150 $\times 10^3$ Km from the centre of the earth. The first scintillation counter arrangement was operated with energy thresholds of 45 KeV, 450 KeV and 4.5 MeV; it also measured the total ionisation produced in the crystal (NaI 39 $\times$40 mm). Terrestrial radiation: Maximum intensity was found at 26,000 Km; at 55 $\times 10^3$ Km the terrestrial corpuscular radiation was negligible. In the region 40-50 $\times 10^3$ Km it was estimated that N(> 45 KeV):N(> 450 KeV):N(> 4.5 MeV) as was $1:10^{-2}:10^{-5}$. Most of the ionisation results from the bremsstrahlung produced by the absorption of electrons of $\sim$ 50 KeV in the Al shield. The maximum energy density measured by the second scintillation counter was 2×10^{11} eV cm^{-2} sec^{-1} sterad^{-1}; this is 100 times less than the data obtained by Van Allen in the 4th American satellite. Cosmic radiation: Above 66 $\times 10^3$ Km the intensity was found to be constant with altitude. The Geiger counter registered a flux of 2.3 particles cm^{-2} sec.$^{-1}$. The photon intensity was: 45-450 KeV, 3.2 ± 0.1 photons cm^{-2} sec^{-1} sec; 450-4500 KeV, 1.0 ± 0.1 photons cm^{-2} sec^{-1}, some of which must be created in the surrounding material. W.O.Lock

NUCLEUS

539.14

396 ON THE ROLE OF NON-CENTRAL FORCES IN NUCLEAR STRUCTURE. B.Jancovici.

Ann. Phys. (Paris), Ser. 13, Vol. 4, No. 5-6, 689-744 (May-June, 1959). In French.

Investigates whether the spin-orbit forces in complex nuclei may be a second-order effect of tensor forces, following the methods of Brueckner; the effective spin-orbit force is much too small, at least with the approximations used. Also explains the β-lifetimes of C^{14} and B^{12} with the help of non-central forces. R.J.N.Phillips

539.14

397 A NOTE ON THE GENERAL THEORY OF THE NUCLEAR MANY-BODY PROBLEM. Yang Li-ming.

Sci. Record (China), New Series, Vol. 1, No. 6, 395-7 (Dec., 1957).

Some of the conventional expressions of Brueckner theory are quoted, and it is shown that the usual theory is the lowest order term in what is formally an expansion in t. The next order term is given. E.J.Squires

539.14

398 ON THE OPTICAL MODEL OF THE NUCLEUS. L.Verlet.

Ann. Phys. (Paris), Ser. 13, Vol. 4, No. 5-6, 643-87 (May-June, 1959). In French.

The optical potential for neutrons is derived from central two-body forces in second order perturbation theory, treating the nucleus as an infinite Fermi gas and the mean potential in intermediate states as energy-independent. With a suitable choice of two-body forces, the main characteristics of the optical potential are given fairly well up to 200 MeV. R.J.N.Phillips

539.14

399 TREATMENT OF THE GROUND STATE OF LIGHT NUCLEI. F.Beck.

Z. Phys., Vol. 156, No. 3, 555-60 (1959). In German.

The ground state energy of nuclei, interacting via short-range singular two-body interactions, is obtained by a method which combines a variational procedure with the two particle correlations, obtained from solutions of the Bethe—Goldstone equation. Although no numerical results have been obtained so far it is hoped that the combination will have some advantage over the usual t-matrix treatment. The lowest-order correction to the t-matrix energy, if self-consistency is not strictly fulfilled (as it is always the case in

practical calculations), and arising from centre of mass effects, is given. Numerical calculations will be difficult except for the lightest nuclei.

539.14

400 THE BINDING ENERGY OF HELIUM NUCLEUS. M.H.Wang and H.L.Tsao.

Science Record (China), New Series, Vol. 3, No. 3, 112-19 (March, 1959).

A variational calculation is made for He^4 with fifteen-parameter trial wave-functions, using various phenomenological central plus tensor two-body potentials. One of the latter is satisfactory.

R.J.N.Phillips

539.14

401 DETERMINATION OF THE HYPERFINE STRUCTURE SPLITTINGS OF THE Sc GROUND STATES $^2D_{3/2}$ AND $^2D_{5/2}$ AND OF THE QUADRUPOLE MOMENT OF Sc^{45}.

G.Fricke, H.Kopfermann, S.Penselin and K.Schlüpmann.

Z. Phys., Vol. 156, No. 3, 416-24 (1959). In German.

The splittings were measured by the atomic beam magnetic resonance method. From these data, the magnetic dipole and electric quadrupole interaction constants are found to be

$a_{3/2} = (269.560 \pm 0.02)$ Mc/s $\quad b_{3/2} = -(26.37 \pm 0.1)$ Mc/s

$a_{5/2} = (109.034 \pm 0.01)$ Mc/s $\quad b_{5/2} = -(37.31 \pm 0.1)$ Mc/s.

The values of the electric quadrupole moment calculated from $b_{3/2}$ and $b_{5/2}$ differ by about 5%, indicating that the configuration $3d\,4s^2$ of the ground states is perturbed by higher configurations. Averaging these two values one obtains for the quadrupole moment of Sc^{45}

$$Q(Sc^{45}) = -(0.22 \pm 0.01) \times 10^{-24}\ cm^2.$$

539.14

402 THE MAGNETIC FIELD AT THE NUCLEUS OF Sm^{+++} INDUCED BY PARAMAGNETISM OF 4f-ELECTRONS.

J.Kanamori and K.Sugimoto.

J.Phys. Soc. Japan, Vol. 13, No. 7, 754-5 (July, 1958).

In order to clarify the interpretation of experimental results for the gyromagnetic ratio of the first excited state of the nuclide Sm^{152} (Abstr. 10020 of 1959), calculations of the induced magnetic field at the nucleus due to an external field have been carried out as a function of temperature. It is assumed that the nucleus interacts with a thermal average of the electronic magnetic moment and in carrying out the summation, attention is not confined to the lowest J level, thereby destroying the proportionality of the induced field to inverse temperature. The induced field is also given as a function of temperature for other rare earth ions. R.A.Ballinger

539.14

403 SIGN OF g IN MAGNETIC RESONANCE, AND THE SIGN OF THE QUADRUPOLE MOMENT OF Np^{237}.

M.H.L.Pryce.

Phys. Rev. Letters, Vol. 3, No. 8, 375-6 (Oct. 15, 1959).

It is pointed out that the sign to be allotted to $g_{\parallel}$ is not arbitrary but can be determined experimentally. In the case of the neptunyl ion $g_{\parallel}$ is negative; a reconsideration of the hyperfine structure of the resonance in $(NpO_2)Rb(NO_3)_3$ then leads to a negative sign for the quadrupole moment of Np^{237}. E.F.W.Seymour

539.14

404 CHARGE DISTRIBUTIONS OF NUCLEI OF THE 1p SHELL. U.Meyer-Berkhout, K.W.Ford and A.E.S.Green.

Ann. Phys. (New York), Vol. 8, No. 1, 119-71 (Sept., 1959).

New data have been obtained at energies of 160 to 420 MeV for the scattering of electrons by Be^9, B^{10}, B^{11}, N^{14}, and O^{16}. A detailed analysis of these elastic scattering data and of other available data for p-shell nuclei is carried through, using various methods and a wide variety of assumed functional forms of the nuclear charge distribution. It is possible to fix rather accurately the spherically symmetric part of the charge distributions of Li^6, C^{12}, N^{14}, and O^{16}, and with less accuracy, those of Be^9 and B^{11}. Central densities are uncertain in all cases. Quadrupole scattering appears to be important in N^{14}, in B^{11}, and possibly in Be^9, and a crude estimate of the quadrupole moment of N^{14} is inferred from the data. The quadrupole scattering depends sensitively on the source of the quadrupole moment, as well as on its value. Regularities within the p-shell are discussed, and connection made with the properties of heavier nuclei. Be^9 and all heavier nuclei have a common value of peak particle density corresponding to a mean particle spacing of $(1.13 \pm 0.01) \times 10^{-13}$ cm. Only Li^6 fails to reach this density of saturated nuclear matter.

539.14

405 7.656 MeV E0 TRANSITION IN C^{12}. D.E.Alburger.

Phys. Rev. Letters, Vol. 3, No. 6, 280-1 (Sept. 15, 1959).

Measurements are reported on the decay modes of the 7.656 MeV excited state of C^{12} formed by bombarding a thin Be target with He^{++} ions at 5.38 and 5.8 MeV. Assuming this level to be 0^+, Cook et al. (Abstr. 1924 of 1958) have suggested the following partial widths for these three modes of decay: $\Gamma(\alpha) \sim 0.5$ eV; $\Gamma(3.28) \sim 0.0015$ eV, $\Gamma(e^{\pm}) \sim 5 \times 10^{-5}$ eV. In the measurements described the intensity of the nuclear pair lines from the 4.43 and 7.656 MeV levels were compared giving: $\Gamma(e)/\Gamma(\alpha) = 8.2 \times 10^{-7} R$, where R is ratio of neutron populations for the two states. An approximate experimental value for R is ~ 8 giving $\Gamma(e^{\pm})/\Gamma(\alpha) \sim 7 \times 10^{-6}$ which is a factor of 15 less than that predicted by Cook et al. This discrepancy is most probably due to an incorrect estimate of the magnitude of $\Gamma(\alpha)$.

A.E.I. Research Laboratory

539.14

406 HIGH NUCLEAR EXCITATION AS A NUCLEAR FORCE PROBE. D.B.Beard.

Phys. Rev. Letters, Vol. 3, No. 9, 432-3 (Nov. 1, 1959).

Argues that the level densities of highly excited nuclei are a sensitive measure of the nuclear well shape. R.J.N.Phillips

539.14

407 LIFETIMES OF THE 118 keV AND 139 keV LEVELS OF Tm^{169} MEASURED BY A NEW METHOD.

A.E.Blaugrund.

Phys. Rev. Letters, Vol. 3, No. 5, 226-7 (Sept.1, 1959).

Describes a method of measuring lifetimes of $\sim 10^{-11} - 10^{-10}$ sec, applicable to levels lying between two low-energy highly converted γ-transitions. The velocity of the conversion electrons from the two γ-rays is modulated by an r.f. field ~ 2000 Mc/s generated by a magnetron. The electrons pass to two β-spectrometers adjusted to accept the electrons corresponding to each transition, passing the r.f. field at zero phase. By measuring the coincidence rate between the spectrometer outputs as a function of phase shift between the modulating fields applied to the two groups of electrons, the delay between the two γ-rays, and hence the lifetime of the state, can be determined. Values of $(6.2 \pm 1.0) \times 10^{-11}$ sec and $(2.9 \pm 0.7) \times 10^{-10}$ sec were obtained for the half-lives of the 118 keV and 139 keV levels respectively of Tm^{169}. The half-life of the 97 keV level of Pt^{195} was found to be 2×10^{-10} sec. R.E.Meads

539.14

408 LIFETIME OF THE 402 keV LEVEL OF ARSENIC 75. M.Vergnes.

C.R. Acad. Sci. (Paris), Vol. 249, No. 20, 2057-9 (Nov. 16, 1959). In French.

The lifetime was measured by a delayed coincidence method. A value of $1.8 \pm 0.4 \times 10^{-9}$ sec was obtained for the half-life in agreement with a value previously obtained by resonant scattering (Abstr. 5021 of 1959). L.L.Green

539.14

409 708 keV GAMMA-RAY IN P^{30}. J.J.Singh.

Phys. Rev., Vol. 115, No. 4, 1015-6 (Aug. 15, 1959).

It is found that the 708 keV gamm-ray in P^{30}, arising from a transition between the second excited state and the ground state, is a strongly mixed M1 and E2 transition. It is suggested that the observed E2/M1 amplitude ratio indicates the operation of selection rules for M1 radiation in self-conjugate nuclei.

539.14

410 RESONANT ABSORPTION BY THE 9.17 MeV LEVEL IN N^{14}. S.S.Hanna and L.Meyer-Schützmeister.

Phys. Rev., Vol. 115, No. 4, 986-9 (Aug. 15, 1959).

The 9.17 MeV radiation from the reaction $C^{13}(p,\gamma)N^{14}$, $E_p = 1.75$ MeV, was used to obtain resonant absorption in the inverse process $N^{14} + \gamma \rightarrow N^{14*}(E_{ex} = 9.17\ MeV)$. The strength of the absorption was measured as a function of absorber thickness. Analysis of the measurements gives $\Gamma = (77 \pm 12)$ eV and $\omega\Gamma_\gamma = (14.5 \pm 2)$ eV. The latter value indicates dipole radiation.

539.14 : 539.2

411 NUCLEAR RESONANCE ABSORPTION OF GAMMA RAYS IN Ir^{191}.

P.P.Craig, J.G.Dash, A.D.McGuire, D.Nagle and R.D.Reiswig.

Phys. Rev. Letters, Vol. 3, No. 5, 221-3 (Sept. 1, 1959).

The resonance absorption of the 129 keV γ-ray from the first

xcited state of Ir^{191} was measured at temperatures down to 1.5°K. At low temperatures there is an appreciable probability of absorption or emission of γ-rays with absorption of the nuclear recoil by the crystal as a whole without phonon emission (Mössbauer, Abstr. 9040 of 1958). The recoil loss of energy by the γ-ray is then small compared with typical nuclear level widths and resonance absorption of the radiation can be detected. An Os^{191} (half-life 16 days) source was employed as the source of the radiation and the transmission of Pt and Ir foil absorbers was measured inside a cryostat. Measurement of foil transmission versus thickness for equal source and foil temperatures of 4°K led to an estimate of 300 ± 25°K and 262 ± 30°K for the Debye temperatures of Os and Ir. The temperature dependence of the transmission agreed with the predictions of Visscher (to be published). Doppler shift of the energy of the γ-ray was achieved by oscillating the source with respect to the foils and gave a value of $(3.72 \pm 0.74) \times 10^{-6}$ eV for the width of the 129 keV level.

R.E.Meads

539.14

412 NUCLEAR RESONANCE ABSORPTION OF GAMMA RAYS AT LOW TEMPERATURES.

L.L.Lee, Jr, L.Meyer-Schutzmeister, J.P.Schiffer and D.Vincent.

Phys. Rev. Letters, Vol. 3, No. 5, 223-5 (Sept. 1, 1959).

Resonance absorption of the 129 keV γ-ray from the first excited state of Ir^{191} was measured using the experimental technique developed by Mössbauer (Abstr. 9040 of 1958), of cooling the sample to liquid nitrogen temperatures. At these and lower temperatures there is an appreciable probability that the nuclear recoil momentum after γ-emission is taken up by the crystal as a whole, and the energy shift of the γ-ray due to recoil loss is greatly reduced. Doppler shift of the γ-ray energy was achieved by rotating Os^{191} sources on a turntable so that the relative velocity with respect to the foil absorbers could be varied. Foils and sources were cooled. The width of the 129 keV level was found to be $(3.5 \pm 0.4) \times 10^{-6}$ eV. Variation of absorption with temperature was compared with the theory of Visscher (to be published). Measurements, with greater experimental uncertainty, on the 100 keV γ-ray from the first excited state of W^{182} gave 0.73×10^{-6} eV for the width of this level.

R.E.Meads

539.14

413 NUCLEAR RESONANCE FLUORESCENCE WITH SOLID SOURCES: Mg^{24}, Si^{28}, Cr^{52}, Sr^{88} and Ce^{140}.

S.Ofer and A.Schwarzschild.

Phys. Rev. Letters, Vol. 3, No. 8, 384-6 (Oct. 15, 1959).

The lifetimes of the first excited 2+ states of some even-even nuclei were measured using the method of self-absorption of resonance scattered γ-rays. The energy required for compensation of the recoil energy loss on emission and absorption is provided by the Doppler shift arising from the recoil velocity from the preceeding β and γ rays. In two cases where the lifetime is known from Coulomb excitation experiments the results agree well. The enhancement relative to Weisskopf estimates are stated to be about 13.

L.L.Green

539.14

414 ISOMERISM OF Hf^{179}.

K.W.Hoffmann, I.Y.Krause, W.D.Schmidt-Ott and A.Flammersfeld.

Z. Phys., Vol. 154, No. 4, 408-18 (1959). In German.

The gamma and internal conversion spectra of the ~ 19 sec Hf^{179} isomer were studied with a 4π-geometry scintillation spectrometer. The following results were established. At 161 keV, the total conversion coefficient is $\alpha_{161} = 35 \pm 2$, and the K-conversion coefficient is $\alpha_{K\,161} = 19.4 \pm 1.2$, in good agreement with the coefficients calculated for an M3 transition. At the energy of the second transition, $E_2 = (217 \pm 2)$ keV, the total conversion coefficient is $\alpha_{217} = 0.055 \pm 0.010$. It is therefore concluded that this transition proceeds by E2 radiation. Spin and parity of the ground state and the excited state of the isomer then agreee with Nilsson's scheme for deformed nuclei. As a by-product, the half-life of the isomer is determined to be (18.6 ± 0.2) sec.

S.J.St-Lorant

539.14

415 FINAL STATE INTERACTION IN $^5He_\Lambda$ DECAY.

R.Ammar, R.Levi Setti, W.E.Slater, S.Limentani, P.E.Schlein and P.H.Steinberg.

Nuovo Cimento, Vol. 13, No. 6, 1156-64 (Sept. 16, 1959).

The distribution of certain kinematic quantities defined in the decay $_\Lambda He^5 \rightarrow \pi^- + p + He^4$ are interpreted as being due to the presence of a strong final state interaction. In particular the data are discussed with reference to two simple theories, one of which takes into account the specific $\pi - He^4$ nuclear interaction. The experimental evidence, although not conclusive, is consistent with the expectation that the $p - He^4$ $p_{\frac{3}{2}}$ resonance plays an important role in determining the final state configurations.

539.14

416 NONMESONIC/MESONIC DECAY RATIO OF HELIUM HYPERFRAGMENTS. P.E.Schlein.

Phys. Rev. Letters, Vol. 2, No. 5, 220-3 (March 1, 1959).

A search for decay modes of helium hyperfragments was carried out in Ilford K5 and L4 emulsions. 33 examples of nonmesonic decay of the $_\Lambda He$ produced in K^- capture stars with range $\geq 59\ \mu$ and decaying with at least two visible prongs have been found. In the same stack 22 π^--mesonic decays of $_\Lambda He$ with connecting tracks $\geq 50\ \mu$ were also found. The experimental ratio thus determined was $33/22 = 1.5 \pm 0.4$. Although this value can be considered a lower limit (one prong nonmesonic decays were not included), it still disagrees with the results of theoretical calculations. Calibration curves and discussion of possible experimental biases are given. Tentative phenomenological interpretation is put forward.

G.Martelli

539.14

417 DECAY OF LITHIUM-7 HYPERNUCLEUS. P.H.Fowler.

Phil. Mag. (Eighth Ser.), Vol. 3, 1460-2 (Dec., 1958).

A Li^7 hypernucleus, created by K^- capture at rest in a photographic emulsion, was observed to have decayed according to the scheme

$$_\Lambda Li^7 \rightarrow \pi^- + He^4 + He^3.$$

The binding energy of the Λ^0 in the nucleus was found to be 5.2 ± 0.5 MeV, in agreement with former, less accurate, measurements.

S.J.Goldsack

539.14

418 DOUBLE-HYPERFRAGMENT EVENT. D.H.Wilkinson, S.J.St-Lorant, D.K.Robinson and S.Lokanathan.

Phys. Rev. Letters, Vol. 3, No. 8, 397-8 (Oct. 15, 1959).

Describes an event involving two mesonically decaying hyperfragments emitted from the same star, produced by a 4.5 BeV/c π^- meson in nuclear emulsion. From arguments based on the probable nature and the spatial correlation of the two connecting tracks, it is suggested that the event can be interpreted as the formation of a short-lived Ξ hypernucleus.

S.J.St-Lorant

539.14

419 ON THE ALPHA DECAY OF STRONGLY DEFORMED ODD-A NUCLEI. O.Prior.

Ark. Fys., Vol. 16, Paper 2, 15-18 (1959).

Points out a correlation between the hindrance factors of odd-A α-transitions and certain properties of the parent and daughter nuclei.

R.J.N.Phillips

539.14

420 CIRCULAR POLARIZATION OF GAMMA RADIATION FOLLOWING ALLOWED BETA TRANSITIONS. R.M.Steffen.

Phys. Rev., Vol. 115, No. 4, 980-5 (Aug. 15, 1959).

The degree of circular polarization of gamma rays following allowed beta transitions was investigated as a function of the angle $\Theta_{\beta\gamma}$ between beta-particle momentum and gamma direction and as a function of the energy of the beta particle. The anisotropy of the beta-gamma circular polarization correlation observed for pure Gamow—Teller transitions ($\Delta I = 1$) is used to determine the validity of $C_A' = C_A$. The experimental results for Co^{60} and Na^{22} are $W(\Theta_{\beta\gamma}) = 1 - (0.345 \pm 0.019)(v/c) \cos \Theta_{\beta\gamma}$ and $W(\Theta_{\beta\gamma}) = 1 + (0.35 \pm 0.02)(v/c) \cos \Theta_{\beta\gamma}$, respectively. These values yield $C_A' = (1 \pm 0.2)C_A$. The degree of circular polarization of the gamma rays following mixed beta transitions ($\Delta I = 0$) confirms the existence of V-A interference terms. For Sc^{46} and Na^{24} the beta-gamma circular polarization correlations, $W(\Theta_{\beta\gamma}) = 1 + (0.24 \pm 0.02)(v/c) \cos \Theta_{\beta\gamma}$, and $W(\Theta_{\beta\gamma}) = 1 + (0.07 \pm 0.03)(v/c) \cos \Theta_{\beta\gamma}$, were observed. From these measurements the ratios of Fermi and Gamow--Teller components for the Sc^{46} beta transition, $(M_F/M_{GT})^2 = 0.13 \pm 0.04$, and for the Na^{24} beta transition, $(M_F/M_{GT})^2 = 0.002 \pm 0.010$, were determined.

539.14

421 SEARCH FOR HIGHER-ORDER EFFECTS IN ALLOWED BETA DECAY. R.M.Steffen.

Phys. Rev. Letters, Vol. 3, No. 6, 277-9 (Sept. 15, 1959).

A search was made for p and d wave effects in allowed β-decay by attempting to detect a small anisotropy in the allowed $\beta-\gamma$ directional correlation. Measurements were made using Na^{24}, Sc^{46}, Co^{60} and Na^{22} sources and significant anisotropy was found only from the Na^{22} source. The experimental results are compared with the anisotropies predicted by Morita and the recent β-decay theory of Gell-Mann. In the case of the Na^{22} results the predictions of the Gell-Mann theory are of the wrong sign.

A.E.I. Research Laboratory

539.14

422 ELECTRON CAPTURE DECAY OF ORIENTED NUCLEI. A.Gelberg.

Phys. Rev. Letters, Vol. 3, No. 8, 378-80 (Oct. 1, 1959).

Suggests an experiment to measure the angular distribution of recoil nuclei from this process, using resonant scattering of the γ-rays emitted after decay. R.J.N.Phillips

539.14

423 POLARIZATION OF CONVERSION ELECTRONS FOLLOWING BETA DECAY. R.L.Becker and M.E.Rose.

Nuovo Cimento, Vol. 13, No. 6, 1182-225 (Sept. 16, 1959).

Because of the breakdown of the symmetry principles in weak interactions, β-decay provides a means of producing polarized nuclei. In allowed transitions only first rank polarization, and in forbidden transitions higher odd rank orientation, is produced. This orientation is manifested in the polarization of subsequent radiations. The present work contains an essentially complete discussion of the polarization of internal conversion electrons from the K-shell. In allowed transitions there is an appreciable longitudinal and also transverse polarization. The latter is in the plane of the momentum vectors of the β-particle and conversion electron. In general these polarizations also appear in forbidden transitions where contributions from higher odd rank orientation are present. In addition, the forbidden transitions are characterized by a component of polarization perpendicular to the β-conversion electron plane. This component, which arises from the even rank orientations (for example, alignment), is a "classical" effect of the coincidence observation. Unfortunately, this transverse polarization is very small (a few percent at most) under practical conditions. Expressions for the polarization components are given in terms of extensively tabulated angular correlation coefficients and "particle" parameters for the three types of polarization. Numerical results for the longitudinal and transverse in-the-plane polarization parameters are included for mixed as well as for pure multipole transitions. Particular decay schemes involving allowed and first forbidden unique β-transitions are considered in detail and numerical values for these polarizations are given.

539.14

424 EXACT MEASUREMENT OF THE RATIOS OF THE INTERNAL CONVERSION COEFFICIENTS FOR 411.8 keV γ-QUANTA IN Hg^{198}.

V.M.Kel'man and R.Ya.Metskhvarishvili.

Zh. eksper. teor. Fiz., Vol. 36, No. 3, 694-6 (1959). In Russian.

The following internal conversion coefficient ratios were obtained for 411.8 keV γ-rays in the shells and subshells of Hg^{198}: $K/L = 2.69 \pm 0.02$; $L_I : L_{II} : L_{III} = 1 : (1.05 \pm 0.02) : (0.45 \pm 0.01)$; $L : M : N : O = 1 : (0.252 \pm 0.004) : (0.077 \pm 0.004) : (0.018 \pm 0.002)$. Within the accuracy of the measurements the experimental ratios agree with the theoretical ones presented in the tables of Sliv and Band (1958).

RADIOACTIVITY

539.16

425 THE DECAY OF Mg^{23}. R.S.Storey and K.G.McNeill.

Canad. J. Phys., Vol. 37, No. 9, 1072-4 (Sept., 1959).

Mg^{23} was produced by irradiation of magnesium in the bremsstrahlung beam of a 23 MeV betatron. Using NaI scintillation counters the γ-ray spectrum in coincidence with annihilation quanta from the β^+ decay ($\tau_{1/2} = 12$ sec) of Mg^{23} was examined. True coincidences between annihilation quanta were excluded by the geometrical arrangement. The spectrum exhibited a peak at a γ energy of 440 keV from which it was estimated that 6.5% of the decays proceed via the first excited state of Na^{23}. The log ft value for the β branch to the ground state was 3.7 and for the other branch 4.5, corresponding, respectively, to a superallowed and an allowed transition. R.E.Meads

539.16

426 THE DECAY OF Bi^{208}. C.H.Millar, T.A.Eastwood and J.C.Roy.

Canad. J. Phys., Vol. 37, No. 10, 1126-36 (Oct., 1959).

It has been observed that Bi^{208} decays mainly by K- and L-electron capture to the 2.615 MeV first-excited level of Pb^{208}. Decay to known Pb^{208} levels above the 2.615 MeV level has been shown experimentally not to occur in more than 3% of the Bi^{208} disintegrations, in agreement with an analysis of the mass differences in this region which indicates that such decay modes are energetically impossible. Positrons are not emitted in more than 5% of Bi^{208} disintegrations. The value of the ratio of K X-rays to 2.615 MeV γ-rays has been measured to be 0.23 ± 0.01. Assuming that the ground state of Bi^{208} is 5^+ and that the theory of Brysk and Rose is accurate in the region near the K-capture threshold, this ratio measurement leads to a value of 2.807 MeV for the total decay energy of Bi^{208}. This agrees with the value 2.75 ± 0.01 MeV obtained from reaction cycle analysis. New measurements of the Bi^{208} half-life have revealed an error in the previous measurement, the best value now being 7.5×10^5 years to within a factor of three. Incidental to the main experiment an upper limit of 0.5% has been measured for the positron decay of Bi^{207}.

539.16

427 THE DECAY OF NEODYMIUM-147. P.R.Evans.

Phil. Mag. (Eighth Ser.), Vol. 3, 1061-8 (Oct., 1958).

The β transitions from Nd^{147} were studied in the new prolate spheroidal field spectrometer. Three components of the spectrum were separated by $\beta-\gamma$ coincidence techniques. The γ-rays were studied in a scintillation counter and coincidence between conversion lines and γ-rays were recorded. On the basis of these results a new mode of decay for Nd^{147} is proposed.

539.16

428 DECAY OF Pm^{144}. K.S.Toth and O.B.Nielsen.

Phys. Rev., Vol. 115, No. 4, 1004-7 (Aug. 15, 1959).

Pm^{144} was produced by an (α,n) reaction on Pr^{141} in the Copenhagen cyclotron. The half-life of Pm^{144} was determined and found to be closer to 450 days rather than to the previously reported value of 300 days. The decay of the nuclide to levels in Nd^{144} was studied, using a 100-channel gamma-ray analyser and a six-gap β-ray spectrometer. Three γ-rays were found, with energies 474, 615, and 695 keV. It was determined that the three γ-rays are E2 transitions and that they are in cascade with one another. A decay scheme for Pm^{144}, consistent with the experimental data, is proposed.

539.16

429 γ-RAY SPECTROSCOPY OF ARTIFICIAL RADIONUCLIDES COLLECTED BY AIR FILTRATION AT THE GROUND. G.Aliverti, F.Demichelis and G.Lovera.

Nuovo Cimento, Vol. 13, No. 2, 453-5 (July 16, 1959).

Gamma-ray spectra of radioactive materials present in the atmosphere due to nuclear and thermonuclear explosions were measured using scintillation counters. The sources were obtained by filtration of air samples ~ 100 cubic metres in volume, collected at ground level, through filter papers. The total activities of the samples were shown to be inversely proportional to the time after the explosion. Measurements on the γ-ray peak at about 0.75 MeV due to Zr^{95} and Nb^{95} showed that the activity due to these isotopes increases rapidly in the months immediately following an explosion. R.E.Meads

539.16

430 COSMIC-RAY-PRODUCED Si^{32} IN NATURE. D.Lal, E.D.Goldberg and M.Koide.

Phys. Rev. Letters, Vol. 3, No. 8, 380 (Oct. 15, 1959).

Si^{32} has been detected in the marine environment. Its half-life (approx. 700 yrs) bridges the gap in time periods which can be studied by the two cosmic-ray-produced isotopes C^{14}(5570 yrs) and H^3(12.5 yrs). The global production rate obtained was 2.0×10^{-4} Si^{32} atoms $cm^{-2}sec^{-1}$. The corresponding inventory of Si^{32} on the earth is 1.75 kg. The activity of Si^{32} was measured by counting the activity of its daughter nuclide P^{32}. Sponges which lay down an opaline (silicon dioxide) skeleton derived from the silica in marine waters provide a natural means of concentration. C.F.Barnaby

539.16

431 THE MEASUREMENTS OF GAMMA RAY DOSE RATE. S.Okamoto and Y.Ikebe.

Tech. Rep. Engng Res. Inst. Kyoto Univ., Vol. 9, No. 7 (Rep.No. 59), 113-27 (March, 1959).

The dose-rate distribution was measured by means of an air-filled cylindrical ionization chamber inside a 1938 curie irradiation arrangement consisting of 37 pencil type Co^{60} sources placed coaxially, the experimental value at the centre of the core being in excellent agreement with that calculated theoretically. In a preliminary experiment with a parallel plate ionization chamber the ionic mobility and recombination rate were shown to depend on the electrode separation and interelectrode voltage. An expression for the ion collection efficiency is derived as a function of a characteristic parameter which depends on the geometry and electrical characteristics of the ionization chamber. The dose-rate is found to be fairly uniform within the irradiation chamber and to decrease rapidly with distance from the latter; its variation with ionization-chamber wall-thickness is presented graphically. I.C.Demetsopoullos

NUCLEAR REACTIONS

539.17

432 INELASTIC DIFFRACTION SCATTERING. J.S.Blair.

Phys. Rev., Vol. 115, No. 4, 928-38 (Aug. 15, 1959).

The mechanism of inelastic diffraction scattering, introduced by Drozdov and Inopin to discuss scattering from nuclei with quadrupole surface deformation, has been extended for scattering amplitude linear in the deformation to arbitrary multipolarity. The resulting angular distributions and gamma-ray angular correlations correspond closely to Born approximation predictions. The model provides a natural explanation for why the inelastic angular distribution of strongly absorbed projectiles are characterized by sharp and persistent oscillations. Comparison is made to observed inelastic scattering of α-particles and deuterons by light nuclei. Large quadrupole deformations are indicated in many nuclei. The systematic appearance in 4n nuclei of states corresponding to octupole excitation is noted.

539.17

433 RESONANCE DETECTION OF NEUTRON ENERGY GROUPS FROM THE $Mn^{55}(p,n)Fe^{55}$ REACTION. L.L.Lee, Jr. and F.P.Mooring.

Phys. Rev., Vol. 115, No. 4, 969-73 (Aug. 15, 1959).

The excitation energies of low-lying levels in Fe^{55} and the Q-value of the $Mn^{55}(p,n)Fe^{55}$ reaction were measured by determining the proton energies at which 257 keV neutrons are produced in this reaction. The ratio of the number of neutrons scattered by a $\frac{1}{2}$ in. thick lithium slab to the number of neutrons transmitted was measured as the energy of a proton beam striking a thin manganese target was varied monotonically. Peaks in the ratio curve, indicating the presence of 257 keV (the energy for resonant neutron scattering from lithium) neutron groups from the reaction, occur at particular proton energies, and Q-values can readily be computed. A ground-state Q-value of (−1.011 ± 0.005) MeV was measured for the $Mn^{55}(p,n)Fe^{55}$ reaction and states in Fe^{55} were located at excitations of 437, 936, 1315, 1414, and 2156 keV. Advantages and limitations of the method are discussed.

539.17

434 (p,n) CROSS SECTION AND PROTON OPTICAL-MODEL PARAMETERS IN THE 4 TO 5.5 MeV ENERGY REGION. R.D.Albert.

Phys. Rev., Vol. 115, No. 4, 925-7 (Aug. 15, 1959).

(p,n) cross-sections were measured for 18 medium-weight nuclei in the 4 to 5.5 MeV region. In this energy region, de-excitation of the compound nucleus by neutron emission is largely favoured over charged particle emission; consequently, the (p,n) reaction dominates competing compound-elastic and inelastic scattering processes. The experimental results are compared with theoretical reaction cross-sections predicted by the optical model for protons. It is found that the parameters which provide the best theoretical fit to these data also provide reasonable fits to neutron total, nonelastic, and elastic cross-sections measured elsewhere when the latter are compared with theoretical cross-sections predicted by the optical model for neutrons. It is concluded that the intrinsic nuclear well depths for protons and neutrons are equal to within ±7% uncertainty.

539.17

435 SPALLATION OF BISMUTH BY 380 MeV PROTONS. E.T.Hunter and J.M.Miller.

Phys. Rev., Vol. 115, No. 4, 1053-57 (Aug. 15, 1959).

Bismuth was bombarded by the 380 MeV proton beam of the Nevis cyclotron to determine production cross-sections of various spallation products. Products isolated and assayed were radioactive isotopes of polonium, bismuth, lead, thallium, mercury, gold and platinum. Each of these elements was separated from the bismuth targets, carefully purified, and counted using a NaI(Tl) crystal scintillation counter having 4π geometry and 99_{-4}^{+1}% efficiency for photons between 20 and 100 keV. A mass-yield curve was constructed from these results and compared to the mass-yield curve constructed from available Monte Carlo calculations. The calculated data fit the experimental data quite well for products within about 20 mass number units of the target. A lower limit to the total spallation cross-section of 1.14 ± 0.05 barns was obtained.

539.17

436 INTERPRETATION OF "ANOMALOUS INELASTIC SCATTERING". C.D.Goodman.

Phys. Rev. Letters, Vol. 3, No. 5, 230-1 (Sept. 1, 1959).

Studies of (p,d) reactions show that the reaction mechanism is direct; only a few levels in the residual nucleus are excited; that the shell model provides a good description of the states which are excited; and that the reaction may be considered as an interaction between the proton and the neutron which it picks up only. Results are presented for the relative cross-section versus Q for a number of these reactions in the region of shell closure at neutron number 50. It is suggested that the shell model may also describe that states involved in (p,p') reactions, although Cohen (Abstr. 4714, 7373 of 1957; 5036 of 1959) assumes that in this case, in contrast to that of (p,d) reactions, collective states are excited preferentially. An experimental programme designed to resolve this difference of opinion is suggested. The (p,d) spectrum for iron is presented and discussed in relation to the (p,p') data already published, from the point of view of a shell model explanation for both types of reaction. A.E.I. Research Laboratory

539.17

437 DISTRIBUTION OF TOTAL RADIATION WIDTHS OF Cu^{59}. J.H.Carver and G.A.Jones.

Phys. Rev. Letters, Vol. 3, No. 6, 276-7 (Sept. 15, 1959).

By bombarding separated Ni^{58} with protons up to 4.3 MeV, total radiation widths of 158 resonances were obtained from the yield of 81 sec Cu^{59}, the annihilation radiation being measured with a NaI spectrometer. After removing the average trend of width increasing with energy, a statistical distribution of widths was found consistent with the theory of Porter and Thomas (Abstr. 1619 of 1957). The value of $\nu = 2.9 \pm 0.6$ indicates that about 3 partial widths make up the total radiation width. A.Ashmore

539.17

438 ENERGY SPECTRUM AND ANGULAR DISTRIBUTION OF ALPHA PARTICLES OF THE REACTION $B^{11}(p,\alpha)Be^{8*}$(2.9 MeV) IN THE REGION OF THE 163 keV RESONANCE. I. D.Kamke.

Z. Phys., Vol. 156, No. 4, 603-20 (1959). In German.

The energy spectrum consists of a broad line (0.8 MeV) at 3.88 MeV and a continuum from 0.05 to 4.9 MeV. The shape of the continuum depends on the angular distributions of the decays taking part in the reaction. The energy spectrum was measured under 90° with respect to the proton beam (CsI + photomultiplier and amplitude discriminator). It shows anisotropies of the α-emissions with strong interference in the 163 keV resonance.

539.17

439 ENERGY SPECTRUM AND ANGULAR DISTRIBUTION OF THE α-PARTICLES OF THE REACTION $B^{11}(p,\alpha)Be^{8*}$(2.9 MeV) IN THE REGION OF THE 163 keV RESONANCE. II. D.Kamke.

Z. Phys., Vol. 156, No. 4, 621-32 (1959). In German.

Calculations and discussion of the measurement of the energy spectrum under 90° with respect to the proton beam.

539.17

440 STRIPPING AT LOW ENERGIES. D.H.Wilkinson.

Phil. Mag. (Eighth Ser.), Vol. 3, 1185-8 (Oct., 1958).

Deuteron-induced reactions of low Q-value show strikingly good stripping patterns at low deuteron bombarding energy (less

than 2 MeV). High Q-values lead to bad stripping patterns. This is because, with a low Q-value, stripping can take place when the stripped nucleon is remote from its partner in the deuteron, and is therefore free from disturbing interactions.

539.17

441 RESULTS OF STRIPPING ANALYSIS OF THE REACTION $K^{39}(d,p)K^{40}$.

H.A.Enge, E.J.Irwin, Jr and D.H.Weaner.

Phys. Rev., Vol. 115, No. 4, 949-55 (Aug. 15, 1959).

The MIT-ONR electrostatic generator and the broad-range spectrograph were used to study the energies and angular distributions of protons emitted from a KI target bombarded with 6 MeV deuterons. Excitation energies are given for 52 levels in K^{40}. Orbital angular momenta of captured neutrons in the stripping process are given for 38 of these excited levels and for the ground state. The reaction energy for the ground-state transition was measured as Q = 5.569 ± 0.010 MeV.

539.17

442 EXCITATION CURVES FOR THE REACTIONS $B^{11}(d,2n)C^{11}$, $Be^{9}(\alpha,2n)C^{11}$, $B^{10}(d,n)C^{11}$ AND $C^{12}(d,n)N^{13}$.

O.D.Brill' and L.V.Sumin.

Atomnaya Energiya, Vol. 7, No. 4, 377-9 (1959). In Russian.

Foil cups of boron-polystyrene and beryllium were irradiated with 19 MeV deuterons and 38.5 MeV α-particles respectively. The excitation curves are separated (where necessary) by means of measurements with enriched boron. J.B.Sykes

539.17

443 NEUTRON POLARIZATION IN THE REACTION $D(d,n)He^3$ AT E_d = 8.2 MeV. W.W.Daehnick.

Phys. Rev., Vol. 115, No. 4, 1008-10 (Aug. 15, 1959).

The neutron polarization was measured. By the use of He^4 as a polarization analyser and a triple coincidence technique, systematical errors in the experiment were kept very small, but at a sacrifice in counting rate. Polarization measurements were made at centre-of-mass angles of 0^0, 47^0, and 59^0. The values obtained for the neutron polarization and their probable statistical errors are $P(0^0) = (-)0.007 \pm 0.007$, $P(47^0) = -0.097 \pm 0.060$, and $P(59^0) = -0.101 \pm 0.060$.

539.17

444 EXCITATION FUNCTIONS FOR ALPHA-INDUCED REACTIONS ON ZINC-64. N.T.Porile.

Phys. Rev., Vol. 115, No. 4, 939-48 (Aug. 15, 1959).

Eleven excitation functions for α-induced reactions on Zn^{64} were measured up to incident energies of 41 MeV. The values of $\sigma(\alpha,p)/\sigma(\alpha,n)$ and $\sigma(\alpha,pn)/\sigma,2n)$ in the region of maximum yield were found to be 1.7 and 9, respectively. Reactions involving α-particle emission account for about 20% of the total inelastic cross-section at 40 MeV. The total inelastic cross-section was found to agree with calculated values for $r_0 = 1.6 \times 10^{-13}$ cm. The competition between different reactions was analysed in terms of the statistical theory by use of a level density expression of the form

$$W(E) = C \exp\{2[a(E-\delta)]^{1/2}\}.$$

Values of a ranging from 0.8 to 2.8 were required to fit the experimental results, indicating that the statistical theory is not completely applicable.

539.17

445 DIFFERENTIAL CROSS SECTIONS OF SOME (α,p) REACTIONS. C.E.Hunting and N.S.Wall.

Phys. Rev., Vol. 115, No. 4, 956-61 (Aug. 15, 1959).

Using 30.4 MeV α-particles, proton differential cross-sections were obtained for the following transitions, corresponding to discrete state of the residual nuclei: $B^{10}(\alpha,p)C^{13}$(gnd); $Na^{23}(\alpha,p)Mg^{26}$ (gnd, 1.83 MeV); $Al^{27}(\alpha,p)Si^{30}$(gnd, 2.24 MeV); and $P^{31}(\alpha,p)S^{34}$(gnd). A proton energy spectrum corresponding to the first 12 MeV of excitation of the residual nucleus was obtained for the case involving the Al^{27} target. The differential cross-sections are interpreted with the aid of predictions of the Butler direct-interaction (surface) theory. It is concluded that this theory is probably a more useful tool in interpreting the results obtained than is the compound nucleus theory. Some deviations from the predictions of the surface direct-interaction calculations are discussed.

539.17

446 SHELL-MODEL THEORY OF INELASTIC SCATTERING ON Be^9. W.T.Pinkston.

Phys. Rev., Vol. 115, No. 4, 963-8 (Aug. 15, 1959).

A study is made of the energy levels of Be^9 with particular emphasis on comparing the inelastic scattering data with the shell-model predictions. The differential cross-sections for inelastic scattering of α-particles are calculated in distorted-wave Born approximation using a central spin-independent potential to represent the interaction between the incident alpha and each target nucleon. The target wave-functions are taken to be intermediate-coupling shell-model wave-function. The agreement between theory and experiment is excellent for values of the intermediate coupling parameter, a/K, which best reproduce the level spectra. The results favour a value a/K = 2.86 over the other popular value, a/K = 1.4. It is suggested that the 1.7 and 11.3 MeV levels do not arise from the $(1p)^5$ configuration.

539.17

447 COMPLEX NUCLEON TRANSFER REACTIONS OF HEAVY IONS. R.Kaufmann and R.Wolfgang.

Phys. Rev. Letters, Vol. 3, No. 5, 232-4 (Sept. 1, 1959).

Stacks of target foils were bombarded with beams of 160 MeV O^{16} and of 140 MeV N^{14} ions. Products formed by stripping from and pickup by the projectiles were collected in gold foils behind the target. Cross-sections for production of F^{18}, O^{15}, and C^{11} are given for Al, Cu and Sn targets. The high cross-sections for exchange of several nucleons are explained on the basis of a "contact-transfer" mechanism. Angular distributions of the products mentioned show a strong forward concentration, as predicted. J.H.Fremlin

539.17

448 MULTIPLE COULOMB EXCITATION IN Th^{232} AND U^{238}. F.S.Stephens, Jr, R.M.Diamond and I.Perlman.

Phys. Rev. Letters, Vol. 3, No. 9, 435-8 (Nov. 1, 1959).

Evidence is presented for multiple Coulomb excitation up to the sixth order in U^{238} and fifth order in Th^{232} when irradiated with A^{40} ions. Values for the transition energies and relative yields are given. C.J.Batty

539.17

449 INELASTIC ELECTRON SCATTERING FROM CARBON. W.C.Barber and F.E.Gudden.

Phys. Rev. Letters, Vol. 3, No. 5, 219-21 (Sept. 21, 1959).

Measurement of the energy spectrum of 42.6 MeV electrons scattered from carbon through 160^0. A scattering peak corresponding to a nuclear excitation of 15.1 MeV is observed, also electrons corresponding to the excitation of the giant resonance. C.J.Batty

539.17

450 SCATTERING OF Co^{60} AND Zn^{65} GAMMA-RAYS IN MEDIUM AND HEAVY ELEMENTS. STUDY OF THE EFFECT OF VACUUM POLARIZATION ON THE ELASTIC SCATTERING OF γ-RAYS. E.Hara.

Ann. Phys. (Paris), Ser. 13, Vol. 4, No. 3-4, 239-85 (March-April, 1959). In French.

Total and elastic scattering cross-sections were measured for the Co^{60} and Zn^{65} gamma-rays in lead, tin and uranium. The experimental apparatus is described in detail and the results discussed theoretically. A.E.I. Research Laboratory

539.17

451 POLARIZATION OF RESONANTLY SCATTERED γ-RAYS. V.Knapp and B.S.Sood.

Proc. Roy. Soc. A, Vol. 247, 369-74 (Sept. 30, 1958).

Polarization of the Au^{198} 411 keV γ-rays, resonantly scattered in Hg^{198}, has been demonstrated with a polarimeter which uses Compton scattering as analysing process. The resonance radiation was found to be strongly polarized with its electric vector parallel to the scattering plane, which confirms the E2 character of the 411 keV transition in Hg^{198}

539.17

452 POLARIZATION OF 0.411, 0.662 AND 1.25 MeV γ-RAYS ELASTICALLY SCATTERED BY LEAD. B.S.Sood.

Proc. Roy. Soc. A, Vol. 247, 375-80 (Sept. 30, 1958).

The polarization of 0.411, 0.662 and 1.25 MeV γ-rays elastically scattered by lead at 90^0 was studied with a γ-ray polarimeter using Compton scattering as the analysing process. At these energies and this angle the only processes contributing to elastic scattering are nuclear Thomson scattering and Rayleigh scattering. Since the intensity and polarization of the Thomson component are readily calculable, the measurements provide a check of theories of Ray-

eigh scattering. The experimental results contradict the predictions of the form factor calculations and agree with those of the refined numerical calculations of Brown and Mayers.

539.17

453 THE PHOTODISINTEGRATION OF NEON.
H.J.Hay and J.B.Warren.
Canad. J. Phys., Vol. 37, No. 10, 1153-65 (Oct., 1959).

A proportional counter, filled to 4 atm. pressure with pure neon, and a cylindrical gridded ionization chamber, filled to 9 atm. pressure with neon containing some helium, were irradiated with the gamma-ray flux from a thick lithium target bombarded with 500 keV protons. Pulse-height analysis led to the assignment of the following photodisintegration cross-sections in millibarns:

$Ne^{20}(\gamma_{17.6}, \alpha)O^{16}$, 0.05 to the ground state of O^{16}, 0.67 to the 6.06 and 6.14 MeV levels of O^{16}, 1.80 to the 6.91 and 7.12 MeV levels of O^{16};
$Ne^{20}(\gamma_{14.8}, \alpha)O^{16}$, 0.086 to the ground state, about 1.0 to the 6.06 and 6.14 MeV levels;
$Ne^{20}(\gamma_{17.6}, p)F^{19}$, 21 to the ground and low-lying levels at 110, 197 keV in F^{19}, about 5 to the 1.35 and/or 1.57 MeV levels in F^{19}.
$Ne^{22}(\gamma_{17.6}, \alpha)O^{18}$, 0.76 to the ground level.

The $Ne^{20}(\gamma, \alpha)O^{16}$ cross-sections are in good accord with the selection rules put forward by Gell-Mann and Telegdi for the photodisintegration of an even-even nucleus.

539.17

454 ON THE ANOMALOUS BEHAVIOUR OF $d(\gamma,p)n$ NEAR 15 MeV.
S.H.Hsieh and C.R.Lin.
Nuovo Cimento, Vol. 13, No. 3, 665-6 (Aug. 1, 1959).

Preliminary theoretical results are presented to account for the anomalous energy dependence of the angular distribution in the photodisintegration of the deuteron. J.D.Dowell

539.17

455 SCATTERING OF 2 TO 4 MeV POLARIZED NEUTRONS BY CARBON.
W.P.Bucher, W.B.Beverly, G.C.Cobb and F.L.Hereford.
Phys. Rev., Vol. 115, No. 4, 961-2 (Aug. 15, 1959).

The right-left asymmetry in elastic scattering of partially polarized neutrons by carbon was observed for 45° (c.m.) scattering angle and for neutrons in the 2 to 4 MeV energy range. The C^{12} (n,n) polarization, inferred from the measured asymmetries, has a direction and energy dependence in agreement with phase-shift analyses obtained previously by others. The magnitude of the polarization is slightly larger than predicted.

539.17

456 ABSOLUTE ACTIVATION CROSS SECTIONS FOR REACTIONS OF BISMUTH, COPPER, TITANIUM, AND ALUMINUM WITH 14.8 MeV NEUTRONS. A.Poularikas and R.W.Fink.
Phys. Rev., Vol. 115, No. 4, 989-92 (Aug. 15, 1959).

Absolute neutron activation cross-sections at 14.8 MeV were measured for Bi, Cu, Ti and Al based on comparison with the $Cu^{63}(n,2n)Cu^{62}$ reaction (556 mb) which served as a standard for monitoring the flux. The reactions studied, measured half-lives and cross-sections are:

$Bi^{209}(n,\alpha)Tl^{206}$, 4.29 ± 0.05 min, 1.1 ± 0.3 mb;
$Bi^{209}(n,p)Pb^{209}$, 3.31 ± 0.03 hr, 0.83 ± 0.40 mb;
$Bi^{209}(n,\gamma)Bi^{210}$, ≤1.7 mb;
$Cu^{65}(n,2n)Cu^{64}$, 12.85 ± 0.05 hr, 954 ± 130 mb;
$Cu^{65}(n,p)Ni^{65}$, 2.56 ± 0.20 hr, 27 ± 11 mb;
$Ti^{50}(n,p)Sc^{50}$, 1.8 ± 0.2 min, 27 ± 6 mb;
$Ti^{50}(n,p)Sc^{50}$, 22 ± 3 min, 48 ± 15 mb;
$Ti^{50}(n,\gamma)Ti^{51}$, ≤ 9 mb;
$Ti^{49}(n,p)Sc^{49}$, 58 ± 2 min, 29 ± 5 mb;
$Ti^{48}(n,p)Sc^{48}$, 44.0 ± 0.9 hr, 58 ± 8 mb;
$Ti^{47}(n,p)Sc^{47}$, 3.45 ± 0.06 days, 230 ± 40 mb;
$Ti^{46}(n,2n)Ti^{45}$, 3.06 ± 0.08 hr, 50.4 ± 8.0 mb;
$Ti^{46}(n,p)Sc^{46}$, 85 ± 2 days, ~ 520 mb;
$Al^{27}(n,\alpha)Na^{24}$, 15.00 ± 0.06 hr, 114 ± 7 mb;
$Al^{27}(n,p)Mg^{27}$, 9.46 ± 0.02 min, 53 ± 5 mb.

Comparisons of the experimental cross-sections with values estimated according to the continuous theory of the compound nucleus outlined by Blatt and Weisskopf are in agreement within an order of magnitude, except in the case of the bismuth results which exhibit large discrepancies. From irradiations of natural titanium and highly enriched Ti^{50}, a new activity was observed having a half-life of 22 ± 3 minutes. This activity is not produced from enriched Ti^{47} or Ti^{49} samples, and it is therefore assigned tentatively to an isomer of Sc^{50}. Further work on this activity is in progress.

539.17

457 ELASTIC SCATTERING OF 14 MeV NEUTRONS BY Al, S, Ti, AND Co.
C.St Pierre, M.K.Machwe and P.Lorrain.
Phys. Rev., Vol. 115, No. 4, 999-1003 (Aug. 15, 1959).

Differential cross-sections were measured for the elastic scattering of 14 MeV neutrons by Al, S, Ti, and Co over the angular range from 10° to 138° using a ring geometry and a plastic scintillator as detector. The experimental results are essentially in agreement with the optical model calculations of Bjorklund and Fernbach (Abstr. 8978 of 1958).

539.17

458 BACK-ANGLE ELASTIC SCATTERING OF 14.6 MeV NEUTRONS FROM ALUMINUM, COPPER, AND ZIRCONIUM. J.D.Anderson, C.C.Gardner, J.W.McClure, M.P.Nakada and C.Wong.
Phys. Rev., Vol. 115, No. 4, 1010-11 (Aug. 15, 1959).

Differential elastic scattering cross-sections were measured for 14.6 MeV neutrons on Al, Cu and Zr in 5° steps from 85° to 155°. The Cu and Zr angular distributions are in good agreement with optical-model calculations by Bjorklund and Fernbach (Abstr. 8978 of 1958), who employ a spin-orbit coupling term in their potential. The Al differential cross-sections are systematically higher than the predictions at the back angles, indicating that the Bjorklund–Fernbach optical-model parameters which fit the medium and heavy elements are not as successfully applied to an element as light as Al.

539.17 : 539.1.07

459 MEASUREMENT OF SOME (n,γ) SPECTRA WITH A PAIR SPECTROMETER OF HIGH SENSITIVITY.
H.Knoepfel, P.Scherrer and P.Stoll.
Z. Phys., Vol. 156, No. 3, 293-317 (1959). In German.

A pair spectrometer of the 180°-focusing type with high efficiency and good resolution is described. The efficiency was determined as a function of the energy, both theoretically and experimentally, and it is possible, therefore, to use this spectrometer for absolute calibration of gamma rays above 2.5 MeV. The evaluation methods of the pair spectra allow the single line to be determined with an error as little as ±8 keV (from 2.5 to 9 MeV). The neutron-capture gamma spectrum of I^{127}, Cs^{133}, $Ir^{191,193}$, Bi^{200} have been measured. The energy and intensity of the resolved gamma rays are given. From these results it is possible to compute the binding energy of the last neutron and also some unknown levels. With an appropriate experimental arrangement and specially selected neutron-capture gamma spectra, monochromatic gamma rays in the energy range between 3 and 11 MeV can be obtained, which are better and much more intense than corresponding gamma rays from (p,γ) reactions.

539.17

460 ANGULAR DISTRIBUTIONS OF PROTON GROUPS FROM THE $Al^{27}(n,p)Mg^{27}$ REACTION AT 14 MeV.
O.E.Overseth, Jr and R.A.Peck, Jr.
Phys. Rev., Vol. 115, No. 4, 993-8 (Aug. 15, 1959).

A study was made of the high-energy proton groups from the $Al^{27}(n,p)Mg^{27}$ reaction at 14 MeV with emulsion detectors, continuous survey being made in the interval 10°-70° (lab. system). Proton groups corresponding to the residual Mg^{27} nucleus left in the ground state and at excitations of 1.0, 1.6, 2.1, 2.8 and 3.5 MeV are identified. Several of these groups are characterized by a pronounced peaking in forward directions characteristic of direct interaction processes. The protons leading to the ground-state form a peak in the vicinity of 30°, those to the 1.0 MeV level at 36°, and those to the 1.6 MeV level at about 50°. The 3.5 MeV group is not resolved from known close-lying levels and the cluster exhibits an isotropic distribution. The 2.1 and 2.8 MeV groups, corresponding to no previously reported levels in Mg^{27}, also display an isotropic distribution and probably represent several unresolved levels. The three lowest-lying levels shown approximate fits to theoretical curves consistent with reactions proceeding either by direct collision or by excitation of collective modes.

539.17

461 TRITIUM AS A PRODUCT OF FISSION.
E.L.Albenesius.
Phys. Rev. Letters, Vol. 3, No. 6, 274-5 (Sept. 15, 1959).

Irradiated samples of natural and enriched uranium, and of a mixture of transuranic isotopes, were found to contain tritium in a ratio 1 per (1-2) × 10^4 fissions. The tritium did not come by diffusion from the heavy water moderator of the nuclear pile, nor was it a result of irradiation of lithium impurities in the samples, or in the fuel elements. D.W.L.Sprung

NUCLEAR POWER STUDIES

539.17

462 ION TEMPERATURE IN SCYLLA, AS DETERMINED FROM THE REACTION D(d,p)T. D.E.Nagle, W.E.Quinn, W.B.Riesenfeld and W.Leland.
Phys. Rev. Letters, Vol. 3, No. 7, 318-20 (Oct. 1, 1959).

The velocities of protons and tritons from D(d,p)T reactions in Scylla (Abstr. 7400 of 1958) have been measured in the axial direction with a photographically-recording magnetic spectrograph. The observed velocity distributions agree with those expected from thermonuclear reactions in a stationary deuterium plasma at a temperature of 1.3 keV. R.S.Pease

ATOMS

539.18

463 ONE-DIMENSIONAL HYDROGEN ATOM. R.Loudon.
Amer. J. Phys., Vol. 27, No. 9, 649-55 (Dec., 1959).

The quantum-mechanical system which consists of a particle in one dimension subjected to a Coulomb attraction (the one-dimensional hydrogen atom) is shown to have a ground state of infinite binding energy, all the excited bound states of the system having a twofold degeneracy. The breakdown of the theorem that a one-dimensional system cannot have degeneracy is examined. The treatment illustrates a number of properties common to the quantum mechanics of one-dimensional systems.

539.18

464 THEORETICAL AND EXPERIMENTAL STUDY OF TRANSITIONS INVOLVING SEVERAL QUANTA BETWEEN THE ZEEMAN SUBLEVELS OF AN ATOM. J.M.Winter.
Ann. Phys. (Paris), Ser. 13, Vol. 4, No. 7-8, 745-811 (July-Aug., 1959). In French.

The theoretical study of the perturbation of a r.f. field on the Zeeman sublevels of the ground state of an atomic system leads to the frequency and probability of transitions between these levels. The probability is given by a matrix element, but it is shown that the probability can be derived for a transition between two levels even if there is no matrix element directly coupling them. This involves the simultaneous absorption of several quanta. The frequency and probability of transition for sodium vapour is calculated for $\Delta m = 1, 2, 3, 4$. To observe these transitions, a dissymmetry in the population of the Zeeman sublevels is required and this is obtained by optical orientation or pumping. This involves the irradiation of the sodium vapour with its resonance radiation, which is circularly polarized about the direction of the static field. The re-emission of this radiation is studied as a function of the static and radiofrequency fields, and gives good agreement with the theory. The relaxation time is derived from the widths of the lines. G.H.C.Freeman

539.18

465 EXCITATION FUNCTION OF HELIUM 3^1P FOR ELECTRON COLLISIONS.
R.M.St.John, C.J.Bronco and R.G.Fowler.
J. Opt. Soc. Amer., Vol. 50, No. 1, 28-32 (Jan., 1960).

The function for the excitation of the helium 3^1P level by electron impact was determined optically. Light intensity of the $3^1P \rightarrow 2^1S$ transition (5016 A) was detected by a sensitive photomultiplier; its output was measured by a microammeter. The intensity of the 5016 A line was proportional to electron beam current for all currents used and proportional to helium pressure for less than 3×10^{-4} mm pressure imprisonment of resonance radiation enhanced the light intensity. The excitation function has a peak value of 2.4×10^{-18} cm^2; this occurs at an electron energy of 100 eV. Absolute determination of the cross-section was possible through the calibration of the light detection system by a tungsten ribbon standard lamp. The experimental curve is corrected by removing cascade components from it.

539.18

466 MESON CORRECTIONS TO THE HYPERFINE STRUCTURE IN HYDROGEN.
C.K.Iddings and P.M.Platzman.
Phys. Rev., Vol. 115, No. 4, 919-21 (Aug. 15, 1959).

The authors have previously shown (Abstr. 5093 of 1959) that the form factor of the proton, measured by Hofstadter, implies an energy shift in the hyperfine structure of atomic hydrogen. Uncertainties in this method of applying the Hofstadter data, due to the effects of virtual mesons, are investigated in an approximate way and found to be small, of the order of 1-2% of the total correction. Under certain assumptions about the form of the amplitudes for various photoproduction processes, the authors conclude that the value of the fine-structure constant implied by the hyperfine structure measurement of Kusch disagrees with the value obtained from the Lamb shift by 34 ± 21 p.p.m.

539.18

467 RADIAL WAVE FUNCTIONS WITH EXCHANGE FOR Va^{2+}, Kr AND Ag^+. B.H.Worsley.
Proc. Roy. Soc, A, Vol. 247, 390-9 (Sept. 30, 1958).

A generalized programme for calculating atomic radial wave-functions with exchange has been prepared for the Ferranti computer (FERUT) at the University of Toronto (see Abstr. 1989 of 1958). This programme has now been applied to V^{2+}, Kr and Ag^+. The wave-functions for these atoms, together with the energy and initial slope parameters, are presented to the accuracy justified by the physical approximation of the Hartree–Fock formulation. The configurations of Kr and Ag^+ are considerably larger than any which have previously been treated by the self-consistent field process with exchange.

539.18

468 BETA-SPECTROMETRIC STUDY OF THE ANGULAR DISTRIBUTION OF THE K-, L-, AND M+N+....-SHELL PHOTOELECTRONS FROM URANIUM. S.Hultberg and Z.Sujkowski.
Phys. Rev. Letters, Vol. 3, No. 5, 227-9 (Sept. 1, 1959).

The dependence of the emission of photoelectrons from the K, L and M + N + ...-shells of uranium on the angle between the photoelectron and the direction of the incident γ-ray was measured for photon energies of 412, 662, and 1332 keV. A foil converter was placed at the source position of a double focusing β-spectrometer and the γ-source rotated about it in the plane of the central electron orbit in the instrument at a distance of 30 mm from the foil. The importance of the results is discussed in correcting the relative intensities of photoelectric lines recorded in a β-spectrometer with a given angle of acceptance, especially when γ-ray sources of relatively large size are used. R.E.Meads

539.18 : 539.2

469 APPROXIMATE WAVE-FUNCTIONS OF THE VALENCE ELECTRONS OF SOME ATOMS. A.I.Gubanov.
Fiz. tverdogo Tela, Vol. 1, No. 2, 203-7 (Feb., 1959). In Russian.

The approximate radial function for the valence electrons of atoms that preferentially form covalent bonds of the sp^3 type is postulated in the form

$$R = a(e^{-r/r_o} - be^{-r/r'})$$

General formulae for the parameters a and b are derived, and with the aid of empirical values of the covalent and ionic atomic radii, r_k and r_i, the values of a and b for B, C, Al, Si, P, Ga, Ge, Ca, In, Sn and Sb are calculated. Expressions describing the complete wave-function for the s and p electrons are given, and it is shown that while determination of the absolute values of the parameters of various substances with the aid of the proposed functions is not possible, they can be used in semi-quantitative analysis when the establishment of laws governing the variation of these parameters is aimed at. M.H.Sloboda

539.18

470 CAPTURE IN (K^-,p) ATOMS. R.K.Adair.
Phys. Rev. Letters, Vol. 3, No.9, 438-9 (Nov. 1, 1959).

It is shown that high angular momentum changes in the collision of protons in liquid hydrogen with the (K^-,p) atom are strongly forbidden. The effect of this on the theory of Day et al. (Abstr. 13732 of 1959) for reactions of K^- mesons at rest in liquid hydrogen is considered. C.J.Batty

539.18 : 536.48

471 ON PROCESSES OF THE TRANSPORT OF MASSES IN THE SEPARATION OF HELIUM ISOTOPES.
I.P.Peshkov.
ull. Inst. Internat. Froid, Annexe 1958-1, 77-82.

Two methods are described: (1) passing He^4 through a superleak,) fractional distillation. The former is used for enriching He^3 by a ctor 2×10^4 from natural helium. This is passed at a rate of 4 litres of liquid per hour. He^3 at a concentration of 1.6% is further riched in a distillation column which is combined with a superleak at acts as a stripper. The output of 4 l s.t.p. per hour of gas con- ining 40% He^3 can then be further treated by simple batch distil- tion in the same apparatus to give a final product of 4 l s.t.p. con- ining 99.995% He^3. H.London

539.18

472 ATOMIC BEAM RESEARCH ON RADIOACTIVE ATOMS. W.A.Nierenberg.
roc. Nat. Acad. Sci. U.S.A., Vol. 45, No. 4, 429-50 (April, 1959).

The first E.O.Lawrence Memorial Lecture, describing recent ork in the University of California on the determination of the uclear spins, magnetic moments and quadrupole moments of adioactive nuclei, and the electronic angular momenta and agnetic moments for heavy atoms, by the atomic-beam magnetic- esonance technique, as modified for radioactive atoms. J.Hawgood

539.18

473 COLLISION-INDUCED SPIN FLIP OF HYDROGEN ATOMS. O.von Roos.
hys. Rev., Vol. 115, No. 4, 911-18 (Aug. 15, 1959).

The cross-section of a radiationless electronic spin-state ransition (triplet-singlet transition) of two colliding, unexcited, ydrogen atoms is calculated for low relative velocities. The low- elocity limit of this cross-section exhibits a logarithmic divergence nd decreases rapidly to a value of the order of πr_0^2 (r_0 = classical lectron-radius $e^2/4\pi mc^2$) with increasing energy of relative motion.

539.18

474 RESONANCE ELECTRON EXCHANGE IN LARGE-ANGLE SCATTERING OF He^+ ON He AT keV NERGIES. F.P.Ziemba and A.Russek.
Phys. Rev., Vol. 115, No. 4, 922-5 (Aug. 15, 1959).

Recent differential scattering measurements at 5^0 scattering ngle of He^+ on He at energies of 2 to 250 keV (Ziemba and Everhart, bstr. 11523 of 1959) have shown several pronounced resonance eaks when the fraction of the scattered particles which were eutral (electron exchange) was plotted as a function of incident nergy. A detailed comparison of those experimental data is made ith the theoretical predictions of the impact parameter method for esonance electron capture. The agreement between the theory and xperiment is found to be quite good at high energies despite experi- ental indications of a large amount of excitation. The contribution f electron exchange with excitation is then considered in the light f this fact.

539.18 : 530.19

RESONANCE FLUORESCENCE. DIFFUSING RADIATION.
ee Abstr. 53

539.18

475 ELECTRON CAPTURE IN FAST COLLISIONS. D.R.Bates.
roc. Roy. Soc. A, Vol. 247, 294-301 (Sept. 30, 1958).

Consideration is given to the problem of calculating the ross-section describing electron capture in high-energy ollisions between atomic systems. The usual procedure is nsatisfactory in that the cross-section to which it leads is not niquely determined, but instead is improperly dependent on the nteraction potential adopted. A procedure which has not this efect is proposed. The impact parameter and wave treatments re both developed, account being taken in each of the effect of momentum transfer.

539.18

476 HELIUM LINES UNDER THE INFLUENCE OF PERPENDICULAR CROSSED ELECTRIC AND MAG- ETIC FIELDS. W.Steubing and F.Lebowsky.
nn. Phys. (Leipzig), Folge 7, Vol. 4, No. 6-8, 360-72 (1959). h German.

Experimental arrangements are described with H = 30 kOe and E up to 35 kV/cm. The lines 4922, 4471, 4388, 4143 and 4026 A were photographed. The observed splitting patterns can be interpreted if Δm up to 3 is allowed. G.F.Lothian

539.18 : 535.33

477 FIRST SPECTRUM OF CHLORINE; AN EXTENSION BASED ON OBSERVATIONS IN THE 7000 TO 25 000 A REGION. C.J.Humphreys and E.Paul, Jr.
J. Opt. Soc. Amer., Vol. 49, No. 12, 1180-6 (Dec., 1959).

The spectrum of neutral chlorine excited by means of a Raytheon Microtherm unit in electrodeless tubes filled with the pure gas has been observed in the region between 10 000 and 25 000 A. A description has been prepared giving wavelengths, wave-numbers, and relative intensities of 283 radiometrically observed lines. Newly classified lines selected from a recent set of photographic observations by Corliss in the interval between 7000 and 10 000 A are included. Extensions to the established classification include identification of all 22 of the previously unobserved levels of the family associated with the ^3P ion limit, comprising the levels from the $3s^23p^45s$ and $3s^23p^43d$ configuration. From a study of this material, along with his list of wave numbers, Corliss has found fourteen new odd levels. Further systematic combing of the data by use of an automatic computing programme has revealed four additional odd levels. The new odd levels originate probably in the $3s^23p^44f$ configuration.

539.18 : 535.33

478 NEWLY OBSERVED LINES OF ARGON I AND KRYPTON I IN THE LEAD-SULFIDE REGION. E.Paul, Jr, and C.J.Humphreys.
J. Opt. Soc. Amer., Vol. 49, No. 12, 1186-7 (Dec., 1959).

Recordings of the spectra of argon and krypton from microwave-excited electrodeless sources have led to observation of a considerable number of previously unreported lines. These new observations comprise 30 lines of argon between 14 000 and 25 000 A, and 10 lines of krypton between 20 000 and 25 000 A. All are accounted for as transitions between known energy levels.

539.18 : 535.33

479 CONTINUOUS EMISSION OF HYDROGEN PLASMAS. F.Mastrup.
J. Opt. Soc. Amer., Vol. 50, No. 1, 32-5 (Jan., 1960).

The continuous absorption coefficients for the bound-free and free-free transitions of H and H^- as well as the total absorption coefficients are given for hydrogen plasmas of 1, 10, 30, 100, and 300 atm pressure and temperatures of 10 080, 12 600, and 16 800°K in the wavelength range from 2000 to 40 000 A. In order to calculate the free-free transitions of H^- the tables of Chandrasekhar and Breen have been extended to include $\theta = 0.4$ and $\theta = 0.3$. The results of these calculations, namely the free-free absorption coefficients for H^- per neutral hydrogen atom in the ground state and unit electron pressure, are given for $\theta = 0.4$ and $\theta = 0.3$. Finally, from the total absorption coefficients, the continuous emission from a 1-cm thick layer of the hydrogen plasmas under consideration has been derived. It is shown that for certain temperatures and pressures the continuous emission becomes so strong that the blackbody intensity of the corresponding temperature is reached for all wavelengths under consideration. This makes the plasma, in particular, useful for photolysis work and absorption spectroscopy.

539.18 : 539.19

480 NOTES ON THE SPECTRA OF OXYGEN. P.W.F.Gribbon.
J. atmos. terrest. Phys., Vol. 9, No. 5-6, 326-8 (1956).

There are still numerous gaps in knowledge of the conditions under which various atomic and molecular spectra of oxygen can be excited. These have a bearing on the interpretation of the spectra of the aurora and airglow, and of the light emitted by discharge tubes containing air or oxygen. The present notes contain a brief account of some observations on oxygen spectra excited in electrode less discharge and by electron beams.

539.18

481 PRECISION MEASUREMENT OF Kα X-RAY LINES FROM RARE EARTH ELEMENTS. P.Bergvall.
Ark. Fys., Vol. 16, Paper 5, 57-68 (1959).

Precision measurements of the $K\alpha_1$ and α_2 X-ray lines of rare earth elements are reported. The accuracy in the wavelength determination is given as 0.004 XU. Good agreement is obtained

with $L_{II}-L_{III}$ level differences obtained from L spectra. An interpolation of element 61 is given, making the list of elements 57-71 complete.

539.18

482 SPIN RELAXATION OF OPTICALLY ALIGNED RUBIDIUM VAPOR. W.Franzen.

Phys. Rev., Vol. 115, No. 4, 850-6 (Aug. 15, 1959).

A new optical method of study is described. The pumping radiation, consisting of circularly polarized D_1 resonance radiation, is suddenly shut off and then turned on again after a known time interval. The relaxation which takes place during the interval of darkness causes the vapour to become more opaque to the pumping radiation at a rate which is determined by the relaxation time. A large degree of alignment, as well as a relaxation time of about 80 msec, were observed in a closed-off evacuated cylindrical glass cell completely lined, except for 1/200 of the wall area, with a thin film of tetracontane ($C_{40}H_{82}$). The variation of relaxation time with buffer gas pressure was studied in this cell and in an unlined glass cell. From the observations with the unlined cell, diffusion coefficients for rubidium in neon and argon of 0.31 cm^2/sec and 0.24 cm^2/sec, respectively, can be deduced. Observed cross-sections for disorientation collisions between aligned ground-state rubidium atoms and neon, argon, krypton, and xenon atoms are 5.2×10^{-23} cm^2, 3.7×10^{-22} cm^2, 5.9×10^{-21} cm^2, and 1.3×10^{-20} cm^2, respectively. In the evacuated tetracontane-lined cell, the relaxation time decreased by 30% for a tenfold increase in rubidium vapour pressure. An explanation for this relatively weak dependence is suggested. The longest observed relaxation time was approximately 0.4 sec in a tetracontane-lined cell filled with neon to a pressure of 3 cm Hg.

539.18

483 ANOMALOUS PRECURSOR SIGNALS IN HELIUM SHOCKS. H.G.Voorhies and F.R.Scott.

Phys. of Fluids, Vol. 2, No. 5, 576-7 (Sept.-Oct., 1959).

Strong electromagnetically driven shocks through helium–deuterium mixtures showed light emission ahead of the main shock. In the main emission, the He line at 5876 A was 1.9 A wide, but in the precursor it was not more than 0.7 A. It is suggested that resonance absorption of photons emitted by the electric discharge excited He to the $3\ ^1P$ level; collisions then caused a spin change to the ^3D state, leading to emission of the ^3D-^3P line at 5876 A.

A.G.Gaydon

539.18

484 EXCITATION TEMPERATURE OF CHROMIUM IN THE SHOCK TUBE. G.Charatis and T.D.Wilkerson.

Phys. of Fluids, Vol. 2, No. 5, 578-9 (Sept.-Oct., 1959).

Measurements of relative intensities of Cr I lines between 4500 and 5000 A excited by reflected shock waves through neon containing a trace of $Cr(CO)_6$ are used to derive excitation temperatures. Results tend to come low, especially at high temperatures (10^4 °K) where the excitation temperature is only 0.6 of the expected gas kinetic temperature. Three possible causes are suggested.

A.G.Gaydon

MOLECULES

539.19 : 537.52

485 DISSOCIATION PROCESSES IN BENZENE AND BENZENE DERIVATIVES IN A GLOW DISCHARGE. STUDIES ON THE SPECTRA OF THE PARENT MOLECULES AND RADICALS. H.Schüler and M.Stockburger.

Z. Naturforsch., Vol. 14a, No. 3, 229-39 (March, 1959). In German.

Describes in some detail a technique for studying dissociation processes, by spectrometry and otherwise, in a glow discharge tube. Spectral line intensities were measured with a photomultiplier tube. Predissociation is discussed, in relation to the particular cases studied, and information on the spectra of radicals is given.

J.D.Craggs

539.19

486 FORCE CONSTANTS OF SOME SYSTEMS OF THE BENT SYMMETRICAL XY_2 TYPE.

K.Venkateswarlu and P.Thirugnanasambandam.

Z. phys. Chem. (Leipzig), Vol. 212, No. 3-4, 138-44 (1959).

The four force constants f_d, f_α, f_{dd}, and $f_{d\alpha}$ of some triatomic molecules, ions and groups of the bent symmetrical XY_2 type have been obtained, using Wilson's group-theoretical method.

539.19

487 POTENTIAL CONSTANTS OF XY_4 AND XY_3Z TYPES OF MOLECULES AND RADICALS.

K.Venkateswarlu, V.Somasundaram and M.G.P.Krishna.

Z. phys. Chem. (Leipzig), Vol. 212, No. 3-4, 145-8 (1959).

The group-theoretical method of evaluating force constants of molecules from observed Raman and infrared data has been applied to eighteen molecules and radicals of XY_4 type belonging to the point group T_d and six molecules of XY_3Z type belonging to the point group C_{3v}. More general potential functions have been used in both cases.

539.19

488 MASER STATES IN AMMONIA — INVERSION. A.A.Vuylsteke.

Amer. J. Phys., Vol. 27, No. 8, 554-65 (Nov., 1959).

The purpose of the paper is to discuss the inversion effect in ammonia in terms of a simple square-well approximation to the potential. This effect is of some present interest since two so-called inversion states have recently been used to achieve maser action in ammonia. A brief discussion of general mechanical features of the ammonia molecule and a semiclassical derivation of the rotational energy spectrum is followed by a discussion of inversion doubling in the vibrational spectrum and a brief treatment of the internal dynamics of the molecule. This is followed by a discussion of the Stark effect on the inversion doublets. The paper is then concluded with a brief description of the principle of the ammonia beam maser.

539.19

489 POTENTIAL CURVE OF THE $B^2\Sigma_U^+$ STATE OF THE N_2^+ MOLECULE. R.Grandmontagne and R.Eido.

C.R. Acad. Sci. (Paris), Vol. 249, No. 3, 366-8 (July 20, 1959). In French.

The use of a corrected Morse potential is illustrated and checked by a calculation of the values of the rotational constant B for v = 11 and 18.

R.F.Barrow

539.19

490 SOLVENT EFFECT ON THE INTENSITY OF CN STRETCHING VIBRATION FOR SOME NITRILES.

A.Foffani, C.Pecile and F.Pietra.

Nuovo Cimento, Vol. 13, No. 1, 213-18 (July 1, 1959).

The frequencies and intensities for the $\nu(C\equiv N)$ bands in $CH_3.CN$, $CH_2{=}CHCN$, $CH_3.OCN$, C_6H_5OCN, C_6H_5CN, 3-cyanpyridine, and 4-cyanpyridine were measured in a variety of solvents in the infrared region. The intensity values obtained and the order of increasing solvent effect are different from that predicted by the Polo–Wilson relation. For the nitriles the band intensities increased with the polarity of the solvent; for the keto-nitriles, however, this trend is reversed. This difference is presumably due to the presence of two competing bond moments (CO and CN) in the keto-nitriles.

W.J.Orville-Thomas

539.19

491 EMISSION LINE OF THE TRANSITION F = 5/2 → 3/2, J = 1, K = 1 IN THE ROTATIONAL SPECTRUM OF THE CH_3I^{127} MOLECULE. N.G.Basov and B.D.Osipov.

Optika i Spektrosk., Vol. 4, No. 6, 195-7 (June, 1958). In Russian. English summary: PB 141047T-11, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

The principle of three-level maser operation was used to study this emission line, by applying auxiliary (pump) radiation at a frequency corresponding to the J = 2 → 1, F = 3/2, K = 1 transition in gaseous CH_3I^{127}; high resolution may be obtained. The increase of sensitivity obtained by this method (about 100 times that of the usual absorption method) enables the gas to be contained in a resonant cavity. This cavity is simultaneously resonant and independently tunable at the two transition frequencies. The maximum intensity of the emission line is 10^{-8} cm^{-1} at a gas pressure of $3\text{-}5 \times 10^{-3}$ mm Hg. The apparatus, consisting of a modified Stark spectrometer, is described.

S.A.Ahern

539.19

492 DETERMINATION OF MOLECULAR CONSTANTS FROM BAND SPECTRA USING THE METHOD OF PARABOLIC INTERPOLATION. V.A.Loginov.

Optika i Spektrosk., Vol. 6, No. 3, 304-14 (March, 1959). In Russian.

Describes a procedure for calculation of the molecular constants and for estimation of their precision using experimental

ta on the rotational structure of electron-vibration-rotational nds of diatomic molecules. This procedure employs a least-uares parabolic interpolation method described by Chebyshev d Dolittle's method of solving normal equations. By way of ustration the procedure is applied to a particular band of BeO.
A.Tybulewicz

539.19 : 535.33

493 THE PRESSURE-INDUCED ROTATIONAL ABSORPTION SPECTRUM OF HYDROGEN. II.
P.Colpa and J.A.A.Ketelaar.
olecular Phys., Vol. 1, No. 4, 343-57 (Oct., 1958).

For Pt I, see Abstr. 2962 (1958). A formula is derived for the tegrated intensity of pressure-induced rotational transitions in re gases and gas mixtures at moderate pressures. This formula applied to the pressure-induced rotational spectrum of hydrogen, scribed in Pt I. A good agreement between the observed and the lculated intensities can be obtained if it is assumed that the duction of the transition moments is mainly caused by the quad-pole field of the hydrogen molecule. In an analogous way, the tensity of the induced simultaneous vibrational–rotational trans-ion in mixtures of carbon monoxide and hydrogen is calculated.

539.19

494 THEORY OF THE PRESSURE-INDUCED ROTATIONAL SPECTRUM OF HYDROGEN.
Van Kranendonk and Z.J.Kiss.
anad. J. Phys., Vol. 37, No. 10, 1187-98 (Oct., 1959).

The theory of induced infrared absorption developed previously applied to the pressure-induced rotational spectrum of hydrogen. he intensity of the rotational band is due mainly to the quadrupolar duction effect, and to a small interference effect between the adrupolar and overlap moments. From the experimental data on e binary absorption coefficients, values of the angle-dependent verlap moments are obtained for H_2–He, H_2–H_2, H_2–Ne, H_2–N_2, nd H_2–A. A calculation of the overlap moment for pure H_2 is esented. Rosen-type wave-functions appear to be inadequate for calculation of the small angle-dependent rotational as well as ibrational overlap moments. The temperature dependence of the inary absorption coefficient is calculated, taking into account the uantum effects in the pair distribution function, and found to be in ood agreement with the experimental data. The dependence on the rtho-para ratio is also discussed. The double rotational line 1) + S(1) was observed and its intensity measured.

539.19

495 THE 0-0 AND 1-0 BANDS OF THE $A(^3\Pi_i)$–$X(^3\Sigma^-)$ SYSTEM OF NH. R.N.Dixon.
Canad. J. Phys., Vol. 37, No. 10, 1171-6 (Oct., 1959).

NH molecules have been produced during the flash photolysis f HNCO, and the 0-0 and 1-0 bands of the $A(^3\Pi_i)$ – $X(^3\Sigma^-)$ system ave been photographed in absorption in the third order of a 21 ft oncave grating spectrograph. The intensity distribution in the ands showed that the molecules were approximately at room emperature. The lines of lowest J value are identified for 25 ranches of the 0-0 band and 19 branches of the 1-0 band. The nalysis of the 0-0 band leads to a correction of the published line ssignments for this band. The spin splittings in both the A and X lectronic states, and the Λ-doubling in the A state, are considered n detail. Wavelengths in air are given for lines of astrophysical nterest.

539.19

496 ON THE STRUCTURES OF MULTIPLET Σ STATES IN DIATOMIC MOLECULES. (WITH AN APPLICATION TO THE $^7\Sigma$ STATE OF THE MnH MOLECULE). I.Kovács.
roc. Roy. Irish Acad. A, Vol.60, No.3, 15-26 (April, 1959).

It was demonstrated, that the structure of a multiplet Σ term s not altered by perturbations due to far lying terms, only the values constants occurring in multiplet formulae are modified by them a certain extent. If, however, the perturbing term does not lie o far away, then there is the possibility that the multiplet structure ill be changed by the perturbation. Thus the anomalous multiplet plitting of the $^7\Sigma$ term of MnH can be interpreted as the perturbation a not too far lying $^7\Pi$ term. A satisfactory agreement was found etween experiment and theory.

539.19

497 THE VACUUM ULTRA-VIOLET ABSORPTION SPECTRA OF THE HALOGEN MOLECULES. I. CHLORINE.
Lee and A.D.Walsh.
rans Faraday Soc., Vol. 55, Pt 8, 1281-92 (Aug., 1959).

The absorption spectrum of chlorine in the wavelength range 2100-1070 A was photographed. Continuous absorption extending to short wavelengths of ~ 1800 A is associated with the intravalency-shell transitions ... $(\sigma_g 3p)(\pi_u 3p)^4(\pi_g 3p)^4(\sigma_u 3p)$, $^{3,1}\Sigma_u^+ \leftarrow X$, $^1\Sigma_g^+$. Banded absorption between 1870 and 1070 A is ascribed to Rydberg transitions leading to the components of the $^2\Pi_g$ and $^2\Pi_u$ ions. Possible assignments are suggested: these are based mainly upon predictions of energy order and vibrational frequencies for Rydberg states.

539.19

498 SPECTROSCOPIC INVESTIGATION WITH THE HELP OF ALPHA PARTICLES.
P.Harteck, S.Dondes and P.Rentzepis.
Z. Phys., Vol. 156, No. 3, 522-4 (1959). In German.

Excitation of the molecules of various gaseous substances by α-particles from a Po^{210} source has been investigated, with special reference to the branching between dissociation and γ-de-excitation. The use of an alternative irradiation source is briefly discussed.

539.19

499 SINGLE CRYSTAL ELECTRON SPIN RESONANCE SPECTRA FOR X-IRRADIATED GLYCINE.
J.J.Windle.
J. chem. Phys., Vol. 31, No. 3, 859-60 (Sept., 1959).

It has not been possible to determine what free radicals give rise to the spectra observed. However, it is shown that (a) the polycrystalline spectrum only accidentally has the appearance of a triplet because of the smearing out of a much more complicated line structure, and (b) there is some Fermi contact interaction, in addition to dipolar interactions, between the unpaired electron and the nuclei in the molecule. J.M.Baker

539.19

500 RADIATION INDUCED FREE RADICALS IN LACTOSE.
F.K.Truby and W.H.Storey, Jr.
J. chem. Phys., Vol. 31, No. 3, 857-8 (Sept., 1959).

The free radicals produced by irradiation of α lactose are unusually stable to heating and hydration. The electron spin resonance spectra in the anhydrous, hydrated and deuterated forms are discussed. J.M.Baker

539.19

501 ELECTRON PARAMAGNETIC RESONANCE AT 4.2°K OF γ-IRRADIATED POLYMETHYL METHACRYLATE AND POLYMETHACRYLIC ACID. D.W.Ovenall.
Nature (London), Vol. 184, 181-2 (July 18, 1959).

At 77°K both polymers gave the well-known spectrum which has been explained by Symons [Trans Faraday Soc., Vol. 54, Pt 3, 409 (March, 1958) and Journal of the Chemical Society, (1959), 277], in terms of a rapidly rotating methyl group so that its three protons interact equally with the unpaired electron. At 4.2°K the spectrum is different, and the line positions, but not their intensities, can be explained in terms of a non-rotating methyl group. J.M.Baker

539.19

502 PARAMAGNETIC RESONANCE OF THE FREE RADICALS OBTAINED BY FREEZING A PLASMA OF H_2S. S.D.Kaitmazov and A.M.Prokhorov.
Zh. eksper. teor. Fiz., Vol. 35, No. 2 (8), 551 (Aug., 1958).
In Russian. English translation in: Soviet Physics–JETP (New York), Vol. 35 (8), No. 2, 381 (Feb., 1959).

The existence of two different radicals, both stable at 77°K, in the dissociation products of H_2S subjected to a high frequency electrodeless discharge, is inferred from the spectra at 1300 and 9400 Mc/s. E.F.W.Seymour

539.19

503 STRUCTURE OF THE METHYL RADICAL.
T.Cole, H.O.Pritchard, N.R.Davidson and H.M.McConnell.
Molecular Phys., Vol. 1, No. 4, 406-9 (Oct., 1958).

C^{13} hyperfine splittings equal to 41 ± 3 gauss were observed in the paramagnetic resonance of a mixture of $C^{12}H_3$ and $C^{13}H_3$ radicals produced by x-irradiation of CH_3I at 77°K. The observed splitting provides strong evidence that CH_3 is a planar molecule.

539.19

504 LONG RANGE SPIN–SPIN INTERACTIONS IN HIGH RESOLUTION NUCLEAR MAGNETIC RESONANCE AND THE CONCEPT OF HYPERCONJUGATION. R.A.Hoffman.
Molecular Phys., Vol. 1, No. 4, 326-30 (Oct., 1958).

Indirect spin–spin couplings between methyl groups attached

to unsaturated organic molecules and protons directly bonded to unsaturated carbon atoms have been observed in several molecules. An attempt is made to account in a qualitative way for the observed spin–spin couplings by ascribing them largely to hyperconjugation between methyl group orbitals and π-electron orbitals. The connection of these observations with electron spin resonance spectra is mentioned.

539.19

505 NUCLEAR MAGNETIC RESONANCE STUDY OF INTRA AND INTERMOLECULAR INTERACTIONS: HYDROGEN BONDS - THE π EFFECT.
R.Freymann, M.Freymann, M.Koechlin, M.Martin and G.Mavel.
Arch. Sci. (Geneva), Vol. 12, Special No., 207-14 (1959). In French.

539.19

506 THE PROBABILITIES OF TRIPLET–SINGLET TRANSITIONS IN AROMATIC HYDROCARBONS AND KETONES. H.F.Hameka and L.J.Oosterhoff.
Molecular Phys., Vol. 1, No. 4, 358-71 (Oct., 1958).

Calculations have been performed on the probabilities of triplet–singlet transitions in benzene and acetone in connection with the decay times of the phosphorescence. The transition probability was determined from the extent to which excited singlet states are mixed with the triplet state. The assumption that in benzene the phosphorescent state has $^3B_{2u}$ properties—so that the $^1B_{1u}$ singlet state is mixed with it—yields the best agreement with the experimental data. In the case of acetone the phosphorescence was considered as a triplet–singlet transition in which only the electrons of the CO group are involved. In both cases the agreement with experiment is as satisfactory as in other calculations on transition probabilities, the figures for the decay times being 190 and 7 sec for benzene and 7.8 and 0.6 msec for acetone. The ratio of the calculated decay times is in good agreement with the experimental result (2.4×10^4 and 1.2×10^4).

539.19

507 EFFECTIVE CHARGE AND IONICITY OF A BOND
F.Matossi. In German.
Z.Naturforsch., Vol.14a, No.9, 791-2 (Sept., 1959). In German.

The effective charge is not at all a useful criterion for ionicity of a bond. This is theoretically understood as being due to the influence of induced atomic dipoles, as explained with a simple classical model. A criterion that would be less objectionable in principle but more difficult to handle follows from the absorption near absolute zero of temperature. This absorption of active vibrations should disappear for covalent molecules but not for ionic ones.

539.19

508 ELECTRIC AND MAGNETIC PROPERTIES OF THE HYDROGEN MOLECULE. T.P.Das and R.Bersohn.
Phys. Rev., Vol. 115, No. 4, 897-910 (Aug. 15, 1959).

The hydrogen molecule ground state has been studied for a long time by valence theorists. Comparison with experiment has been limited to the energy, bond distance, vibration frequency, and the electric and magnetic polarizabilities. Recent radio-frequency experiments on hydrogen have yielded new quantities, the nuclear magnetic shielding constant, the spin–spin coupling constant, and the electric field gradient at the nucleus. In this paper, variation methods are described for the calculation of the new types of polarizability. These methods can be applied to more complex molecules and appear to open new possibilities for the semiquantitative interpretation of the results of high-resolution nuclear magnetic resonance. An extensive comparison is made between the experimental quantities and theoretical values using various wave functions. The most important factor affecting the accuracy of the charge density is the use of an effective nuclear charge.

539.19

509 LARGE MOLECULES IN CARBON VAPOR.
K.S.Pitzer and E.Clementi.
J. Amer. Chem. Soc,, Vol. 81, No. 17, 4477-85 (Sept. 5, 1959).

The molecular orbital theory is used in appropriate semi-empirical forms to predict the properties of carbon vapour. The results indicate that linear polyatomic molecules :C=C=C–C=C: are the important species. Experimental results from the literature for C_3 are combined with the calculated conjugation or resonance energies and with the heats of formation of allene and ethylene to predict heats of formation for all larger carbon molecules. It is found that the odd species have closed shell structures and lower energies than the even species but that the even species should show greater electron affinity. Both of these results are consistent with the mass spectrometric results of Honig and of Chupka and Inghram. Molecular spectroscopic data on C_3O_2 are used to estimate the free energy function increments for the species above C_3. The calculated partial vapour pressures predict C_5 to be the most abundant species in the saturated vapour even at 2000° K with C_7 becoming comparably abundant in the 2500° to 3000° K range. At higher temperatures even larger molecules should become important. The results are shown to be generally consistent with all reliab vaporization data provided the evaporation coefficients decrease rapidly for increasing molecular size and vary for different crystal surfaces of graphite. The calculated electronic energy levels for C_2 and C_3 agree satisfactorily with the observed spectra, and trends are predicted for both even and odd larger species. It is proposed that liquid carbon consists of essentially infinite linear chains of this type. Both entropy and energy considerations lead to predicted heats of fusion of about 10 kcal/(g atom) at 4000° K; the agreement between the two values indicates at least the absence of any serious inconsistency.

539.19

510 RECOMBINATION OF ATOMS AT SURFACES. IV. THEORY OF METHOD AND MEASUREMENT OF ATOM CONCENTRATIONS. J. C. Greaves and J. W. Linnett.
Trans Faraday Soc., Vol. 55, Pt 8, 1338-45 (Aug., 1959).

For Pt III, see Trans. Faraday Soc., Vol. 54, Pt 9, 1323-30 (Sept., 1958). The paper examines two basic features of Smith's method (see Abstr. 1761 of 1943) for studying the recombination coefficients of atoms at surfaces. The first is the formula for the decay in the atom concentration down a tube closed at one end, the atom concentration being maintained constant at the other, in terms of the recombination and diffusion coefficients. It is shown that Smith's formula is only correct at low atom concentrations. A new treatment is given which allows for the fact that diffusion is occurring in a system in which a chemical reaction is taking place. The second is the measurement of absolute and not relative atom concentrations. These are required by this more precise treatment. The Wrede–Harteck gauges used are described and the principles involved in their proper functioning are examined. It is concluded that several types which were proposed and employed are unsatisfactory in principle. Measurement of relative atom concentrations using a catalytic probe showed a direct proportionality to absolute atom concentrations as measured by a Wrede–Harteck gauge, together with some increase in sensitivity. This is only achieved at the cost of a much higher abstraction of atoms from the system by the catalytic probe.

539.19

511 RECOMBINATION OF ATOMS AT SURFACES. V. OXYGEN ATOMS AT OXIDE SURFACES.
J. C. Greaves and J. W. Linnett.
Trans Faraday Soc., Vol. 55, Pt 8, 1346-54 (Aug., 1959).

The surface recombination coefficient γ of oxygen atoms was determined for a number of surfaces (20 oxides and As, Sb and Bi). The atoms were produced by an electrodeless discharge maintained by an r.f. transmitter (8 Mc/s). The decay in atom concentration down a side-tube into which tubes coated with the materials could be introduced was determined by using two Wrede–Harteck gauges. The activities ranged from $\gamma = 3.1 \times 10^{-5}$ for Pyrex to 4300×10^{-5} for CuO. In the first long period, the activities of the oxides of Ca, V, Zn, Ga, Ge and As were small while those of the five metals from Mn to Cu were large. This suggested that the presence of metal ions with incomplete d-shells conferred activity on the surface. However, examination of the results for the other oxides suggested that another factor affecting the activity was the "acidity" or "alkalinity" of the oxide. The former favoured low and the latter high activity. The results obtained here were compared with conclusions that have been drawn regarding the relative abilities of different surfaces to break chains by the removal of atoms and radicals from gaseous mixtures reacting chemically. It is found tha the correspondence between the two types of data is surprisingly close.

539.19

512 RECOMBINATION OF ATOMS AT SURFACES. VI. RECOMBINATION OF OXYGEN ATOMS ON SILICA FROM 20° C TO 600° C. J.C.Greaves and J.W.Linnett.
Trans Faraday Soc., Vol. 55, Pt 8, 1355-61 (Aug., 1959).

The recombination coefficient γ for oxygen atoms on silica was determined for the temperature range 20° to 600° C. The employment of Smith's method using two Wrede–Harteck gauges together with their associated Pirani gauges in a system in which ther

e temperature differences between the various parts is discussed d a satisfactory procedure devised. The activity of the surface creased from $\gamma = 1.6 \times 10^{-4}$ at 20° to 1.4×10^{-4} at 600°C. The raph of log γ against 1/T was not a straight line showing that it is ot possible to explain the change with temperature in terms of a ngle energy of activation. The significance of the present results relation to the changes that are known from other data to occur in e surface of silica as the temperature is raised was discussed. It as concluded that the activity and its change with temperature could e accounted for by supposing that oxygen atoms from the gas phase mbined with loosely bound oxygen atoms in the surface, the defects ken being replaced at once by other oxygen atoms. In these experi- kents oxygen atoms were produced by a micro-wave-maintained discharge. The apparatus for doing this is described. In an appendix details of some experiments that were carried out to study the use- fulness of this method are given.

539.19 : 535.34

513 ON THE STARK EFFECT OF THE MICROWAVE ABSORPTION LINE OF METHANOL AT 19 967.3 Mc/s. H.Dreizler and H.D.Rudolph.
Z. Naturforsch., Vol. 14a, No. 8, 758 (Aug., 1959). In German.

Measured and calculated values of the splitting coefficient agree to within 1.5%. G.F.Lothian

539.19 : 539.18

NOTES ON THE SPECTRA OF OXYGEN. See Abstr. 480

SOLID-STATE PHYSICS

539.2

514 IONIC RADII AND THE ELECTRON THEORY OF THE STRUCTURE OF SOLIDS. A.F.Kapustinsky.
.phys. Chem. (Leipzig), Vol. 209, No. 5-6, 352-9 (Oct. 1958). n German.

A hyperbolic relation between volume and ionic charge is btained for isoelectronic ions. The relationship is applied to a eries of ions, metals of the fifth period, and transuranic elements. J.Franks

539.2

515 ELECTRON DISTRIBUTION IN TRANSITION METALS. W.Hume-Rothery, P.J.Brown, J.B.Forsyth and H.H.Taylor.
hil. Mag. (Eighth Ser.). Vol.3, 1466-7 (Dec., 1958).

It is suggested that great caution is needed in interpreting Weiss nd De Marco's X-ray results (Abstr. 3583 of 1958) on the number of -electrons in these metals, because only a few reflections of low dices were measured. Only a complete three-dimensional electron ensity map is of value for comparison with theoretical models. L.Pincherle

539.2

516 SELF-CONSISTENT FIELD APPROACH TO THE MANY-ELECTRON PROBLEM. H.Ehrenreich and M.H.Cohen.
Phys. Rev., Vol. 115, No. 4, 786-90 (Aug. 15, 1959).

The self-consistent field method in which a many-electron ystem is described by a time-dependent interaction of a single lectron with a self-consistent electromagnetic field is shown to e equivalent for many purposes to the treatment given by Sawada nd Brout. Starting with the correct many-electron Hamiltonian, it is found, when the approximations characteristic of the Sawada–Brout scheme are made, that the equation of motion for the pair reation operators is the same as that for the one-particle density natrix in the self-consistent field framework. These approximations re seen to correspond to (1) factorization of the two-particle density natrix, and (2) linearization with respect to off-diagonal components f the one-particle density matrix. The complex, frequency-dependent ielectric constant is obtained straightforwardly from the self- onsistent field approach both for a free-electron gas and a real olid. It is found to be the same as that obtained by Nozières and Pines in the random phase approximation. The resulting plasma ispersion relation for the solid in the limit of long wavelengths s discussed.

539.2

517 HYPERFINE COUPLING IN CoFe AND CoNi ALLOYS AS DETERMINED BY HEAT CAPACITY MEASUREMENTS. V.Arp, D.Edmonds and R.Petersen.
Phys. Rev. Letters, Vol. 3, No. 5, 212-14 (Sept. 1, 1959).

The effective magnetic field at the nucleus was derived from measurements between 0.35° and 0.7°K, and varies approximately linearly with composition between 1.61×10^5 Oe at 60% Co, 40% Ni o 3.14×10^5 Oe at 5% Co, 95% Fe. There is thus no evidence of ny drastic change of electronic structure in these alloy systems. E.P.Wohlfarth

539.2

518 THE FINE STRUCTURE OF THE K ABSORPTION EDGE OF NICKEL AND OF IRON IN Ni–Fe ALLOYS AT LOW TEMPERATURES. D.Bally and L.Müller.
C.R. Acad. Sci. (Paris), Vol. 249, No. 13, 1099-101 (Sept. 28, 1959). In French.

The fine structure of the K absorption edge of nickel and iron was determined at −160°C for a number of Ni–Fe alloys. No change in absorption was observed in pure nickel or iron on lowering the temperature, but for the alloys a general shift of the K absorption structure towards longer wavelengths was observed. The detailed results are tabulated. T.Mulvey

539.2

519 PROPERTIES OF RUTILE (TITANIUM DIOXIDE). F.A.Grant.
Rev. mod. Phys. Vol. 31, No. 3, 646-74 (July, 1959).

An extensive survey of the literature on the physical properties of rutile is given. An attempt is made to explain these properties in terms of two different models, but a correlation between the various types of measurement (electrical, thermal, etc.) has not been possible because of the poor accuracy and inconsistency of experimental data. Many other properties which are not obviously related to these models are also discussed. The two models considered correspond to: (a) non-interacting, hydrogen-like donor sites, and (b) interacting donor sites, when the overlapping of the donor wave functions is appreciable and a donor band is formed. The depth of such donor levels and bands below the conduction band is found for each model from various types of measurement. These values for the first model vary from 0.02 to 0.35 eV, and for the second from 0 to 0.15 eV. An optical value for the latter model indicates a possible maximum value of 0.24 eV. K.N.R.Taylor

539.2

520 THERMODYNAMIC INTERPRETATION OF THE LONG PERIOD IN CRYSTALLINE HIGH POLYMERS. E.W.Fischer.
Z. Naturforsch., Vol. 14a, No. 5-6, 584-7 (May-June, 1959). In German.

It is suggested that the explanation of the chain-folding, which is assumed in order to account for the long period (of about 120 A), is to be sought not in the kinetics of the crystallization process but in the thermodynamic stability of the crystallites. Calculation is shown to disclose a minimum in the free energy of the crystallites as a function of the folding period. W.Good

Lattice Dynamics

539.2

521 ANALYTIC PROPERTIES OF BLOCH WAVES AND WANNIER FUNCTIONS. W.Kohn.
Phys. Rev., Vol. 115, No. 4, 809-21 (Aug. 15, 1959).

The one-dimensional Schrödinger equation with a periodic and symmetric potential is considered, under the assumption that the energy bands do not intersect. The Bloch waves, $\varphi_{n,k}$, and energy bands, $E_{n,k}$, are studied as functions of the complex variable, k. In the complex plane, they are branches of multivalued analytic and periodic functions, φ_k, and E_k, with branch points, k', off the real axis. A simple procedure is described for locating the branch points. Application is made to the power series and Fourier series developments of these functions. The analyticity and periodicity of $\varphi_{n,k}$, has some consequences for the form of the Wannier

functions. In particular, it is shown that for each band there exists one and only one Wannier function which is real, symmetric or antisymmetric under an appropriate reflection, and falling off exponentially with distance. The rate of falloff is determined by the distance of the branch points k' from the real axis.

539.2

522 A NOTE ON THE OVERLAP INTEGRAL OF TWO HARMONIC OSCILLATOR WAVE FUNCTIONS.

F.Ansbacher.

Z.Naturforsch., Vol. 14a, No.10, 889-92 (Oct., 1959)

This integral,centred about different equilibrium positions, and having different force constants, is evaluated in terms of a finite sum of polynomials. Recurrence relations and the first derivative of the integral with respect to the separation parameter are also given.

539.2 : 534.23

523 MAGNETIC EFFECTS ON SHEAR WAVE ATTENUATION IN SINGLE CRYSTAL COPPER.

J.R.Neighbours and G.A.Alers.

Phys. Rev. Letters, Vol. 3, No. 6, 265-8 (Sept. 15, 1959).

The results are reported on preliminary measurements on the attenuation of 15.9 and 25.9 Mc/s shear waves propagated in the [110] direction in pure Cu single crystals. The acoustic polarization was parallel to either [001] or [110] directions and a magnetic field of up to 15 000 Oe was applied transverse to the propagation direction and either parallel or perpendicular to the acoustic polarization. At the high frequency, oscillations were found in the attenuation field curves in all cases. The results are compared with those of Morse et al. on longitudinal waves, and with unpublished theory by Harrison. Deforming the crystal is found to eliminate the oscillations. Some additional results with longitudinal waves are also mentioned.

L.Mackinnon

539.2

524 EFFECT OF THE CRYSTAL LATTICE FIELD ON OSCILLATIONS OF THE NO_3^- (OR CO_3^{2-}) IONS, AS FOUND FROM THE DATA OF THE INFRARED SPECTRA OF SODIUM NITRATE AND CALCITE. A.A.Shultin.

Dokl. Akad. Nauk SSSR, Vol. 125, No. 4, 767-70 (April 1, 1959). In Russian.

See also Gross and Shultin, Abstr. 3448 (1958). The absorption spectra of single-crystal plates of the isomorphous crystals $NaNO_3$ and $CaCO_3$ (calcite) were studied. The analysis of the selection rules for the vibrations of the NO_3^- (or CO_3^{2-}) ions in the calcite-type crystal lattice shows that, in spite of the decomposition of vibration terms in two components owing to the resonance interaction of the crystal ions, the nature of the infrared spectrum of the crystal is the same as that of the individual ion. Two (for $NaNO_3$) and three (for $CaCO_3$) distinctly resolved maxima were found in the intense bands representing the basic vibration $\nu_2(A_2'')$. A tentative explanation of this absorption anomaly is given. F.Lachman

539.2

525 ANALYTICAL METHODS IN THE THEORY OF ELECTRON LATTICE INTERACTIONS. I.E.P.Gross.

Ann. Phys. (New York), Vol. 8, No. 1, 78-99 (Sept., 1959).

A study is made of the low-lying levels of an electron interacting with a quantized lattice vibration field. To treat the case of arbitrary coupling strength, a canonical transformation is performed. The new lattice variables describe motions carried out partly relative to the instantaneous electron position and partly about mean values depending on the average electron state. In the present work the wave-functions are assumed to be a product of electron and lattice functions in the new variables, and are not translationally invariant. They contain functions describing the tie between particle and field and a function describing the tendency of the particle to be localized in space. The theory that results when these functions are determined in the optimum way is explored, and it is noted that the method points to a natural systematic perturbation theory. The ground state energy and effective mass of a particle is studied in detail. The approach can be directly generalized to treat more complicated Hamiltonians which involve periodic potentials, magnetic fields or many electrons.

539.2

526 ELECTRON INTERACTIONS. II. PROPERTIES OF A DENSE ELECTRON GAS. D.F.DuBois.

Ann. Phys. (New York), Vol. 8, No. 1, 24-77 (Sept., 1959).

For Pt I see Abstr. 8835 (1959). The lowest order exchange correction to the plasmon energy is computed and found to be small in all cases of physical interest. However, the lowest order contributions to the plasmon damping are seen to modify the observed cutoff for plasmon excitation in electron energy loss experiments in a not negligible way. In applying the formalism to such experiments the stopping power of an electron gas is also discussed and the exact lowest order contribution to the single particle damping rate is derived. Using the self-energy method, the correction to the low temperature specific heat of an electron gas is computed exactly to one higher order in r_s (the inter-electron spacing) beyond the calculation of Gell-Mann. It appears that the series in orders of r_s converges reasonably well only for $r_s < 2$. For $r_s < 0.8$ the specific heat is reduced from the value for noninteracting electrons while for $r_s > 0.8$ the specific heat is enhanced from this value. The change in sign appears to be the result of the Pauli Principle. It is concluded from these calculations that the procedure of expansion in orders of r_s gives useful results for values of $r_s < 2$. For intermediate densities ($2 < r_s < 6$) the general perturbation approach may still be valid but a different approximation procedure for treating the polarization effects is needed.

539.2

527 NEW LOOK AT THE THEORY OF ELECTRON–PHONON RESONANCE. II. W.Band.

Amer. J. Phys., Vol. 27, No. 7, 471-7 (Oct., 1959).

The perturbation theory of the transitions between electron-phonon resonance states, developed in Pt I (see Abstr. 12786 of 1959), is here generalized to the many-electron problem, and applied to a discussion of the electrical conductivity of a linear lattice. The significance of the work for an understanding of superconductivity is also briefly discussed.

539.2

528 THE THEORY OF TWO-PHONON SCATTERING OF CONDUCTION ELECTRONS IN ATOMIC CRYSTALS.

A.I.Ansel'm and I.G.Lang.

Fiz. tverdogo Tela, Vol. 1, No. 5, 683-95 (May, 1959). In Russian.

The Weisskopf–Wigner method is used to determine the relaxation time of conduction electrons for two-phonon scattering due to a perturbing potential linear in the atomic displacements. It is shown that the relaxation time for one-phonon scattering automatically takes account of many-phonon processes. The two-phonon scattering due to a potential quadratic in the displacements is treated by first order theory. The relaxation time for this is proportional to T^{-2}. There is a critical temperature at which the relaxation times for one- and two-phonon processes are equal. This is estimated to be of the order of 10^2 - 10^3 °K, but is very sensitive to the electron wave-function in the crystal. R.Berman

539.2

529 QUADRUPOLE SELECTION RULE IN IRON GROUP SPIN-PHONON INTERACTIONS.

R.D.Mattuck and M.W.P.Strandberg.

Phys. Rev. Letters, Vol. 3, No. 8, 369-70 (Oct. 15, 1959).

Points out that spin-phonon transitions in non S-state iron-group paramagnetic salts obey quadrupole selection rules. Application is made to problems of acoustic absorption and ruby masers.

E.P.Wohlfarth

539.2 : 539.14

DEBYE TEMPERATURE OF Os AND Ir, FROM γ-RAY NUCLEAR RESONANCE ABSORPTION. See Abstr. 411

539.2

530 EFFECT OF COULOMB INTERACTION ON ELEMENTARY EXCITATIONS IN SOLIDS. P.Nozières.

Ann. Phys. (Paris), Ser. 13, Vol. 4, No. 7-8, 865-903 (July-Aug., 1959). In French.

An extension of previously published work and with some new material. The Bohm–Pines formalism is generalized to electrons in periodic lattices. An improved treatment of plasmons is given, showing rigorously that for an electron gas there remains only a screened interaction which does not modify appreciably the elementary excitations given by the one-particle theory. For a gas of bosons the only excitations are the plasmons. Minority carriers are accompanied not only by virtual plasmons, but also by individual excitations of the majority carriers. Phenomena of correlations between the minority carriers are investigated, as well as excitons and acoustic plasmons. Finally, the rate of production of plasmons by fast electrons and by X-rays is calculated, results being in qualitative agreement with experiment. L.Pincherle

539.2

531 THE CONNECTION BETWEEN THE POLARIZATION AND THE STRENGTH OF THE ELECTROMAGNETIC FIELD IN THE REGION OF EXCITON ABSORPTION.
A.F.Lubchenko.
Fiz. tverdogo Tela, Vol. 1, No. 5, 709-18 (May, 1959). In Russian.

The theory of electromagnetic waves in crystals containing excitons, developed by Pekar (Abstr. 5151 of 1958) for the case of atoms in equilibrium positions, is generalized for real molecular crystals by a well-known relation between exciton stimulation and lattice oscillation. A differential equation is obtained for the relation between the polarization and the strength of an electromagnetic field in crystals. K.N.R.Taylor

539.2 : 537.311

532 THE DISSOCIATION OF AN EXCITON BY PHONONS IN ATOMIC SEMICONDUCTORS. A.A.Lipnik.
Fiz. tverdogo Tela, Vol. 1, No. 5, 726-33 (May, 1959). In Russian.

A short communication of this work has already been published (Abstr. 4001 of 1958). In the effective-mass approximation for a model with two spherical bands, the transition probability for dissociation of a hole–electron pair is evaluated as a function of its kinetic energy in the bound state. This is compared with the theoretical scattering probability of Ansel'm and Firsov (Abstr. 7224 of 1955). I.D.C.Gurney

539.2

533 ZEEMAN SPLITTING OF EXCITON LINES IN CdS.
R.G.Wheeler and J.O.Dimmock.
Phys. Rev. Letters, Vol. 3, No. 8, 372-4 (Oct. 15, 1959).

Two-fold splitting of three absorption lines occurred in the wavelength region above 4840 A. The g-values of the lines depend on the relative orientation of the magnetic field and the c-axis of the crystal. A small shift took place in the mean position of the split lines, this shift increasing roughly quadratically with magnetic field strength. B.T.M.Willis

539.2

534 THEORY OF THE CREATION OF EXCITONS.
G.G.Taluts and M.Sh.Giterman.
Fiz.Metallov i Metallovedenie, Vol.7, No.2, 291-3 (1959). In Russian.

The activation energy and effective mass of an exciton are calculated on the many electron model assuming weak interactions. Formulae derived agree with Takevti [Prog. theor Phys., Vol.18, 421 (1957)], who used the Heitler–London method on molecular-type wave-functions. [English summary: PB 141126 T-9, obtainable from office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.]. A.F.Brown

539.2 : 539.11

APPROXIMATION METHOD FOR THE POLARON GREEN'S FUNCTION. See Abstr. 332

539.2 : 538.27

535 LOW TEMPERATURE ANOMALY IN THE PROTON RESONANCE OF SOME NICKEL SALTS.
P.H.Kim and T.Sugawara.
J. Phys. Soc. Japan, Vol. 13, No. 8, 968 (Aug., 1958).

The variation of spin–lattice relaxation times and shift of resonance frequency with temperature was studied in the following six nickel salts: $NiSiF_6.6H_2O$; $NiK_2(SO_4)_2.6H_2O$; $Ni(BrO_3)_2.6H_2O$; $Ni(NH_3)_6Cl_2$; $Ni(NH_3)_6(ClO_4)_2$ and $NiCl_2.6H_2O$. In single crystals of the first three salts resonance lines were observed down to the lowest temperature attainable, 1.4°K; in the last three — in both single-crystal and powdered form — the resonance line disappeared at a definite temperature, and the spin–lattice relaxation times exhibited anomalous behaviour. S.A.Ahern

539.2

536 PHOTOSENSITIVE SPIN RESONANCE IN CdS.
J.Lambe, J.Baker and C.Kikuchi.
Phys. Rev. Letters, Vol. 3, No. 6, 270-1 (Sept. 15, 1959).

A spin resonance signal was observed on irradiating a CdS crystal containing Fe impurities with visible light at 4.2°K (max. effect at 5500 A). The signal was removed on irradiation with infrared, 2μ radiation being the most effective. Irradiation with visible light may convert the Fe^{2+} ions to Fe^{3+} ions, which produce the signal. J.Franks

539.2 : 537.311

537 CYCLOTRON RESONANCE IN SEMICONDUCTORS WITH COMPLEX EQUIPOTENTIAL SURFACES. Yu.A.Firsov.
Fiz. tverdogo Tela, Vol. 1, No. 1, 44-61 (1959). In Russian.

A method of calculating the galvanomagnetic effects for equipotential surfaces of arbitrary shape is described. It is shown that complex surfaces may be characterized by several resonance peaks whose intensity depends on the surface geometry only, and that under the conditions of cyclotron resonance the relaxation times can be introduced in the calculations. The results of the theoretical analysis are compared with the experimental data on cyclotron resonance in Si and Ge. M.H.Sloboda

539.2

538 CYCLOTRON RESONANCE IN METALS.
J.C.Phillips.
Phys. Rev. Letters, Vol. 3, No. 7, 327-8 (Oct. 1, 1959).

A qualitative discussion of the effects to be expected if the steady magnetic field is not exactly parallel to the specimen surface, with particular reference to the work of Langenberg and Moore (following abstract). R.G.Chambers

539.2

539 CYCLOTRON RESONANCE IN COPPER.
D.N.Langenberg and T.W.Moore.
Phys. Rev. Letters, Vol. 3, No. 7, 328-30 (Oct. 1, 1959).

Series of resonances up to the 12th harmonic have been found at 24 kMc/s in an artificially grown Cu crystal with its surface parallel to a (110) plane. The observed masses vary between 0.5 m_0 and 5 m_0; most lie between 1.1 m_0 and 1.4 m_0. For most orientations, except along the (100), (110) and (111) axes, two masses are resolved. The general behaviour agrees well with that expected on the basis of Pippard's model (Abstr. 2651 of 1958). R.G.Chambers

539.2

540 ON THE MECHANISM OF ION MOBILITY IN METALS.
V.B.Fuks.
Fiz. tverdogo Tela, Vol. 1, No. 1, 16-30 (1959). In Russian.

Theoretical. The mechanism of ion mobility was studied on a model of free electrons and in the framework of the basic postulates of the kinetic theory of solids. It was shown that movement of ions is determined by the effective mobility which depends not only on the diffusion or self-diffusion coefficient, but also on the electrical properties of metal: length of the free electron path and the cross-section of electron scattering by ions. The character of the movement of the impurity ions and neutral atoms in metals can be determined by analysis of the mechanism of the effective mobility. Movement of the intrinsic ions in a homogeneous metal is associated with the fact that the scattering cross-section of an ion in the active state (state of motion), σ^*, differs from that of a normal ion, σ_0. Consequently, the effective mobility can be measured directly by studying the current transfer phenomena in a homogeneous metal. The change of sign of the isotopic Haeffner effect can be attributed to the fact that the cross-section of electron scattering on active ions is larger than that associated with normal ions. It was concluded that, although the mechanisms of diffusion and electrical conduction are basically different since the former is determined by the interaction between the neighbour atoms and the latter by the interaction between electrons and ions, ion mobility in metals constitutes a link connecting these two phenomena since the effective ion mobility depends both on the diffusion coefficient, and on the character of the interaction between electrons and ions. Consequently, study of the movement of ions in metals may well play an important part in establishing the mechanism of diffusion and electrical conduction, and the interdependence of these two phenomena. M.H.Sloboda

539.2 : 537.311

541 DIFFUSION AND RECOMBINATION IN THE MEASUREMENT OF THE DRIFT MOBILITY. V.N.Dobrovol'skii.
Fiz. tverdogo Tela, Vol. 1, No. 5, 719-25 (May, 1959). In Russian.

Diffusion and recombination were allowed for in the formulae used in the drift mobility measurements. Criteria of applicability of a simplified mobility formula were obtained for the cases of one-dimensional, two-dimensional and three-dimensional propagation of injected carriers. The criteria were checked experimentally. A.Tybulewicz

539.2 : 537.311

542 DIFFUSION ATTENUATION. I. J.A.Swanson.
I.B.M. J. Res. Developm., Vol. 3, No. 1, 13-17 (Jan., 1959).

Perturbation methods are applied to the problem of calculating the attenuation of signals consisting of compensated space charges moving in an electric field of general, but prescribed, form. Asymptotic formulae for attenuation and phase shift are derived

which apply when the diffusion currents giving rise to attenuation are small compared to the field-induced currents. Alternate expansions of the continuity equation, e.g. in terms of the frequency, are discussed.

539.2 : 537.311

543 DIFFUSION ATTENUATION. II.
J.A.Swanson and K.Y.Sih.
I.B.M. J. Res. Developm., Vol. 3, No. 1, 18-24 (Jan., 1959).

The amount of diffusion attenuation is computed as a function of frequency for the case of uniform electric field. Application to drift transistors is discussed.

539.2 : 538.3

544 ELECTRODYNAMICS OF CHARGE CARRIERS OF NEGATIVE EFFECTIVE MASS IN CRYSTALS.
S.Rodriguez.
Phys. Rev., Vol. 115, No. 4, 821-3 (Aug. 15, 1959).

The transport properties of negative-effective-mass carriers in crystals are studied. The electrical conductivity of a sample in which the electron distribution function is weakly-perturbed from its thermal equilibrium value is always positive, even in the presence of a magnetic field. Therefore, cyclotron resonance experiments in equilibrium should display energy absorption, although the negative-mass carriers will circulate in the sense opposite to that of positive-mass carriers of the same charge.

539.2 : 536.21

545 TWO MECHANISMS OF HEAT CONDUCTION.
A.F.Ioffe.
Fiz. tverdogo Tela, Vol. 1, No. 1, 160-1 (1959). In Russian.

Theoretical. It is postulated that in contrast to substances in which the mean length, l, of the free phonon path is of the order of 10a to 100a (where a = lattice parameter), conduction of heat in materials with $l < a$ takes place mainly by exchange of the energy quanta between the neighbouring atoms. This mechanism of heat conduction is reflected in a different temperature dependence of thermal conductivity κ: while scattering of phonons increases with rising temperature which results in a decrease of κ associated with phonons, κ of Ga_2Se_3 (in which $a \cong 5 \times 10^{-8}$ cm, $l \cong 2 \times 10^{-6}$ cm) varies very little between 90 and 430°K. The possibility of a connection existing between the decrease of the probability of scattering of quanta and the decrease of κ on one side, and the departure from the resonance conditions caused by the anharmonic character of the thermal vibrations of strongly bonded atoms on the other, is also discussed. M.H.Sloboda

539.2 : 536.21

546 THE EFFECT OF HALOGENS ON THERMAL CONDUCTIVITY OF SELENIUM. A.A.Bashshaliev.
Fiz. tverdogo Tela, Vol. 1, No. 2, 348-50 (Feb., 1959). In Russian.

Thermal conductivity λ of Se containing up to 0.25% Br was measured. With the increasing Br content λ decreased, passed through a minimum of 1.42×10^{-3} cal cm^{-1} sec^{-1} $(deg\ C)^{-1}$ at 0.065% Br, and then increased to a const. value of 2.0×10^{-3} cal cm^{-1} sec^{-1} $(deg\ C)^{-1}$ at approximately 0.12% Br. The difference between the effects of Br, Cl, and I on λ is discussed in terms of the ionic radii and the atomic weight of these elements in correlation with the crystal structure of Se. M.H.Sloboda

539.2 : 536.21

547 THERMAL CONDUCTIVITY OF INDIUM ANTIMONIDE AT LOW TEMPERATURES.
E.V.Mielczarek and H.P.R.Frederikse.
Phys. Rev., Vol. 115, No. 4, 888-91 (Aug. 15, 1959).

Thermal conductivity measurements were made on a monocrystalline sample of indium antimonide from 10 to 50°K. Umklapp, isotope, and boundary scattering contributions to the thermal resistivity were calculated from theoretical expressions and then subtracted from the measured value of thermal resistivity. The subsequent deduction of impurity scattering gives a value for the number of point impurities which is compatible with that given by electrical measurements.

539.2 : 536.21

548 THE EFFECT OF A STRUCTURAL TRANSFORMATION IN A SOLID ON THE COEFFICIENT OF THERMAL DIFFUSIVITY. APPLICATION TO BARIUM TITANATE.
L.Sicard, L.Eyraud and J.Elston.
C.R. Acad. Sci. (Paris), Vol. 249, No. 5, 642-4 (Aug. 3, 1959). In French.

The thermal diffusivity as a function of temperature was measured for BeO and $BaTiO_3$ by the method described in Abstr. 12165 (1959). A chromel–constantan thermocouple was used for temperatures up to 600° and chromel–alumel from 600° to 1000°C. The curve of thermal diffusivity against temperature for BeO was continuous from 20 to 1000°C, but the curves for $BaTiO_3$ showed evidence of the tetragonal–cubic transformation near to 120°C, but with some hysteresis. S.Weintroub

Defect Properties

539.2

549 DISLOCATION THEORY OF THE FORMATION OF SMALL-ANGLE BOUNDARIES. H.A.Atwater.
Amer. J. Phys., Vol. 27, No. 8, 597-601 (Nov., 1959).

The elastic interaction energy of some simple arrays of edge dislocations is calculated as a function of position of one member of the array on its glide plane. The resulting energy relations are interpreted as binding potentials for the capture of a dislocation by the array. This mechanism is assumed to be operative in the formation of small-angle grain boundaries in crystals.

539.2

550 THE CLIMB OF A DISLOCATION IN A TWISTED WHISKER F.R.N.Nabarro and P.J.Jackson.
Phil. Mag. (Eighth Ser.), Vol. 3, 1105-9 (Oct., 1958).

Gomer's observation (see Abstr. 4520 of 1958) that twisted mercury whiskers have periodic imperfections separated by distances closely related to the pitch of the twist is explained by considering a dislocation which is approximately parallel to, but displaced from, the axis of the whisker. This dislocation is straight in cartesian coordinates, but helical in the coordinates provided by the crystal lattice.

539.2

551 ON THE STABILITY OF DISLOCATIONS IN METAL WHISKERS. J.P.Hirth and F.C.Frank.
Phil. Mag. (Eighth Ser.), Vol. 3, 1110-16 (Oct., 1958).

The possibility of thermally activated slip of dislocations out of metal whiskers is considered. Such an event provides a mechanism for the cessation of whisker growth. It is found that a single axial dislocation will be in unstable elastic equilibrium if it has an edge component with respect to the whisker axis greater than a critical amount. Metastable dislocations with edge components less than this critical amount have an expectation time for slip out of the whisker which is dependent on whisker radius, temperature, and the elastic properties of the whisker material. The effects on whisker morphology predicted by this mechanism are discussed.

539.2

552 THE OCCURRENCE OF STACKING FAULTS IN METALLIC SYSTEMS. J.Spreadborough.
Phil. Mag. (Eighth Ser.), Vol. 3, 1167-73 (Oct., 1958).

A possible qualitative interpretation of the occurrence of stacking faults in metals and alloys is outlined, using an extension of the ideas of Altmann, Coulson and Hume-Rothery. The metals calcium, scandium and titanium, the ϵ-phase in iron–manganese, and the α-solid solutions of various B sub-group elements in the noble metals are treated as examples. The effect of temperature on hybrids is briefly discussed.

539.2

553 DIFFUSION AND SOLUBILITY OF Cd IN Ge.
V.E.Kosenko.
Fiz. tverdogo Tela, Vol. 1, No. 10, 1622-6 (Oct., 1959). In Russian.

The investigation was carried out using the method of labelled atoms (with Cd^{115}). The diffusion of Cd (from vapour phase) into Ge monocrystals yielded the coefficient of diffusion

$$D = 1.75 \times 10^9 \exp(-102000/RT).$$

The maximum solubility of Cd in Ge amounts to 2×10^{18} cm^{-3} (at 840°C). The results of experiments show only a very limited coincidence with the theories so far propounded, although the divergences were reduced by corrections contained in Swalin's paper (Abstr. 839 of 1959). F Lachman

539.2

554 RELATION BETWEEN THE EYRING AND DOOLITTLE DIFFUSION EQUATIONS.
A.W.Lawson.
J. chem. Phys., Vol. 30, No. 4, 1114-15 (April, 1959).

This relation between the activation and free volume theories diffusion is discussed. It is shown that for solids at least, they e practically equivalent. W.Good

539.2

555 ON THE ESCAPE OF IMPURITIES FROM SOLIDS. R.Englman.
hil. Mag. (Eighth Ser.), Vol. 3, 1081-8 (Oct., 1959).

It is shown how the distribution of impurities in a semi-infinite olid may be determined from observations of the escape-rate ross the surface. The results are applicable to other diffusion rocesses.

539.2

556 ETCH PITS IN ZINC. G.Bassi and J.P.Hugo.
. Inst. Metals, Vol. 87, Pt 11, 376-9 (July, 1959).

Metallographic investigations, employing the etch-figure technique, were carried out on coarse-grained zinc containing 0.002% ntentionally added tin. On quenching from 400° C etch pits are not rmed, but annealing between 100° and 400° C leads to their develop-ent. They are very small and numerous at the lower annealing mperatures, but at higher temperatures there is a progressive in-rease in size and decrease in number. Above a limiting tempera-ure a decrease in size occurs. This behaviour can be explained by iffusion of the tin atoms to the dislocations. A mechanism ex-laining the localized chemical attack, which is a pre-requisite to ch-pit formation, is proposed. Several observations indicate that e two parallel boundaries of deformation twins are not equivalent, nd the implications arising therefrom are discussed. Deforma-on twins can be consumed by the matrix and this absorption begins the apex of the twin, where large etch pits having the orientation f the matrix are grouped.

539.2

557 INFLUENCE OF THE IRRADIATION TEMPERATURE ON THE POSITION OF THE F-BAND IN MIX-RYSTALS OF KCl AND NaCl.
. Ottens, A.J.Eland and W.G Burgers.
roc. K. Ned. Akad. Wetensch. B, Vol. 62, No. 5, 268-76 (1959).

The crystals were obtained by quenching from the homogeneous ate. Measurements were made on crystals X-rayed both at room mperature and at the temperature of liquid air. Also the absorp-on is measured at both temperatures. A special attachment for the eckman spectrophotometer is described, which enables such easurements to be carried out. It was found that for these mixed rystals the position of the F-band is dependent on the temperature t which the crystals are irradiated, the maximum lying at a shorter avelength (difference about 10-15 mμ) for irradiation at liquid air mperature than that for irradiation at room temperature. Such a hift is not observed for the pure crystals: here the position of the and is independent of the irradiation temperature. For mixed crys-ls irradiated at liquid air temperature the F-band lies between at for pure NaCl and pure KCl. The "anomalous" position of the aximum of a 10 NaCl/90 KCl crystal irradiated at room tempera-ure as observed by Gnaedinger (position at a longer wavelength than at for pure KCl) disappears for irradiation at liquid air tempera-ure.

539.2

558 ABSORPTION BAND AT 420 mμ IN X-RAY COLOURED KCl-CRYSTALS AND IN MIX-CRYSTALS OF KCl AND aCl. E.Ottens, A.J.Eland, H.B.Zeedijk and W.G.Burgers.
roc. K. Ned. Akad. Wetensch. B, Vol. 62, No. 5, 277-82 (1959).

In X-rayed crystals of KCl and in mixed crystals of NaCl and Cl, an absorption band has been observed at about 420 mμ. The resence of this band is probably due to some unknown impurity in he crystals. The measurements confirm the observation of alperin and Schlesinger (Abstr. 7517 of 1959) that the intensity of he band is highly dependent on the thermal pre-treatment of the rystals; moreover it is unstable at room temperature.

ELECTRICAL PROPERTIES OF SOLIDS

(Superconductivity is included under Low-Temperature Physics)

539.2

559 A THEORY OF CONDUCTIVITY. V.P.Silin.
Fiz. Metallov i Metallovedenie, Vol. 7, No. 3, 331-4 (1959). In Russian.

The electrons in a metal can be considered not as a gas but as a degenerate liquid — the Fermi liquid. (See Abstr. 8604 of 1956; 2031 of 1957). On this model, formulae are derived for the electrical conductivity, magneto-resistive effects, thermal conductivity and for the Thomson coefficient. A.F.Brown

539.2 : 537.311 : 535.34

560 SOME ELECTRICAL AND OPTICAL PROPERTIES OF SIMPLE RHOMBOHEDRAL BORON. F.H.Horn.
J. appl. Phys., Vol. 30, No. 10, 1611-12 (Oct., 1959).

The resistivity of single crystals was measured in the temperature range 77°-1000°K. The results indicated that the impurities occupy very shallow levels and that the thermal activation energy for simple rhombohedral boron is larger than that for complex rhombohedral boron. Optical absorption measurements showed that the absorption curve for the simple form is 0.4 eV nearer the visible than for the complex form. This leads to an estimate of 2 eV for the energy gap of the simple form. B.T.M.Willis

539.2 : 537.3

561 DETERMINATION OF CHARACTERISTIC QUANTITIES OF ELECTRONS IN METALS BY THE METHOD OF THIN FILMS. H.Mayer.
Acta phys. Austriaca, Vol. 12, No. 4, 427-52 (1959). In German.

Review of results obtained by the author and co-workers (Abstr. 2074 of 1956; 7091, 7121-3 of 1957). L.Pincherle

539.2 : 537.3

562 THE ELECTRICAL CONDUCTIVITY OF ZONE MELTED Zr AT LOW TEMPERATURE.
L.Renucci, J.P.Langeron and P.Lehr.
C.R. Acad. Sci. (Paris), Vol. 249, No. 13, 1113-15 (Sept. 28, 1959). In French.

The recrystallisation of α-Zr prepared by the Van Arkel method was compared with that of Zr purified by zone melting, by measurements of electrical conductivity at liquid H and liquid N temperatures. It was found that the zone-melted metal recrystallised at a temperature lower than that of the Van Arkel metal by some 180°C. J.Thewlis

539.2 : 537.3

563 DEPENDENCE OF THE ELECTRICAL CONDUCTIVITY OF POLYMERS ON TEMPERATURE.
N.I.Shishkin and M.P.Vershinina.
Fiz. tverdogo Tela, Vol. 1, No. 5, 798-802 (May, 1959). In Russian.

The electrical conductivities of polystyrene, polymethyl methacrylate, polyvinyl acetate, polyvinyl butyral, polyvinyl formal and polyvinyl ethylal were measured in the region below and above the vitrification temperature. The temperature dependences were found to be similar to those of supercooled monomeric liquids and glasses. A.Tybulewicz

539.2 : 537.3

564 THE TEMPERATURE DEPENDENCE OF THE ELECTRICAL RESISTIVITY OF NICKEL–ZINC AND COPPER–ZINC FERRITES. A.I.Suchkov.
Fiz. Metallov i Metallovedenie, Vol. 7, No. 2, 317-18 (1959). In Russian.

Graphs of $\ln \rho - T^{-1}$ for ferrites show a change of slope at T_c the Curie point. For ferrites containing $Fe_2O_3 + NiO + ZnO$, the slope increases at T_c; for those containing $Fe_2O_3 + CuO + ZnO$, the slope is sharply reduced at T_c. Results agree with the theory of Irkhin and Turov (Abstr. 3995 of 1958). [English summary: PB 141126T-9, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.] A.F.Brown

539.2 : 537.31

565 THE ELECTRICAL PROPERTIES OF $HgIn_2Te_4$. G.Busch, P.Junod, E.Mooser and H.Schade.
Semiconductors and phosphors. (see Abstr. 9597 of 1959) pp. 470-3. In German.

Conductivity, Hall effect and thermoelectric power were measured on polycrystalline and single crystal samples, purified by zone melting. The parameters derived are energy gap at 0°K, 1.55 eV, electron mobility, 200 to 110 cm^2/V sec over the temperature range 350 to 500° C, mobility ratio 1.4. The specimens were intrinsic down to about 220° C. K.W.Plessner

539.2 : 537.31

566 THE HALL EFFECT IN THE Mn–Sb SYSTEM. I.N.Vasil'eva, V.N.Novogrudskii, A.A.Samokhvalov and I.G.Fakidov.
Fiz. Metallov i Metallovedenie, Vol. 7, No. 2, 304-5 (1959). In Russian.

The Hall e.m.f. was measured as a function of applied field for a series of Mn–Sb alloys containing 0-49.6 atomic % Mn. From the resulting curves the authors separate out the values of R_O, the Hall parameter of the non-ferromagnetic phase, and R_f, the anomalous Hall parameter of the ferromagnetic phase MnSb. The results suggest that the Hall e.m.f. may be used as a sensitive indicator of the presence and abundance of a ferromagnetic phase in an alloy. [English summary: PB 141126T-9, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.]. A.F.Brown

539.2 : 537.31

567 GALVANOMAGNETIC PROPERTIES OF CYLINDRICAL FERMI SURFACES. J.M.Ziman.
Phil. Mag. (Eighth Ser.), Vol. 3, 1117-27 (Oct., 1958).

An infinite cylinder has the same general properties, with respect to the connectivity of its plane sections, as the Fermi surface proposed by Pippard (see Abstr. 2651 of 1958) for copper. For this model, the conductivity tensor in an arbitrary magnetic field H is calculated exactly, and then averaged over all orientations of the cylinder axis relative to H. This is taken, without proof, to represent the bulk conductivity of a polycrystalline specimen. It agrees remarkably well, both at low and high fields, with the experimental results on copper, especially in making the transverse magnetoresistance proportional to H. This can be understood physically. There are always some crystallites, specially oriented to the field, where the orbits in k-space are open, or so extended that they are not traversed in the relaxation time. Since some of their conductivity components remain finite they provide leakage paths for the current but, as H increases, their number decreases as 1/H. The observed saturation of the longitudinal magnetoresistance may also be explained by reference to the true Fermi surface and a slight sophistication of the model.

539.2 : 537.31

568 INFLUENCE OF COLLECTIVE EFFECTS ON THE MAGNETORESISTANCE OF METALS. R.A.Coldwell-Horsfall and D.ter Haar.
Phys. Rev., Vol. 115, No. 4, 891-3 (Aug. 15, 1959).

The influence of the correlations between carriers on the magnetoresistance β of metals was investigated. Using the expressions derived by Fletcher and Larson (Abstr. 1862 of 1959), the change in β is evaluated for a one-band model. We have also used Landau's theory of a Fermi liquid as modified by Silin to apply to the conduction electrons in a metal. The change in β both in a one-band and in a two-band model is considered. It is found that for a semiconductor like InSb the change would be negligible, but that for a metal such as Al there would be a change of about 10%.

539.217 : 537.311

569 THE DIFFUSION OF EXCESS ZINC IN ZINC OXIDE CRYSTALS. (INVESTIGATIONS CONCERNING ELECTRICAL CONDUCTIVITY). R.Pohl.
Z. Phys., Vol. 155, No. 1, 120-8 (1959). In German.

The effects of heating zinc oxide crystals in zinc vapour, and later in air, on the electrical conductivity of the crystal were investigated experimentally. Diffusion constants are obtained as a function of temperature. P.T.Landsberg

Semiconductors

539.2 : 537.311

570 PROCEEDINGS OF THE 1958 CONFERENCE ON SEMICONDUCTORS.
J. Phys. Chem. Solids, Vol. 8, 552 pp. (Jan., 1959). See also Nature, Vol. 182, 1067 (Oct. 18, 1958) and Physics Today, Vol. 12, No. 2, 22-5 (Feb., 1959).

For abstracts of some of the papers presented to the above Conference, see Abstr. 5534, 5543, 5559, 5675, 5677, 5679-80, 5685-6, 5698-701, 5711, 5718, 5741, 5874, 5946, 6226, 6234-6, 6239, 6250, 6257-8, 6266, 6271, 6718, 6731, 6750-2, 6766-7, 6825-6, 6883, 6910-15, 6918-22, 6924, 6927-32, 6934-40, 6942, 6944-5, 6947, 6952-67, 6974-77, 6979-82, 6984, 6993-4, 7186, 7492, 7498-500, 7504, 7513-14, 7522-3, 7546, 8095-6, 8107, 8117, 8129, 8134-6, 8139, 8343, 8819-20, 8843, 9610-12, 9615, 9618, 9628, 9666, 10243 and 12016-17 (1959).

539.2 : 537.311

571 A STATISTICAL THEORY OF THE ELECTRICAL CONDUCTIVITY OF SEMICONDUCTORS. I. M.I.Klinger.
Fiz. tverdogo Tela, Vol. 1, No. 6, 861-72 (June, 1959). In Russian.

A general expression for the electrical conductivity obtained by Kubo (Abstr. 2881 of 1955; 8437 of 1957) is used to deduce an electrical conductivity formula for the case of a weak electron–phonon interaction. The new formula is discussed and used in scattering of electrons on polarized phonons. The contribution of virtual transitions and the criterion which determines the smallness of this contribution are also dealt with. A.Tybulewicz

539.2 : 537.311

572 DETERMINATION OF THE ANISOTROPY OF ELECTRICAL CONDUCTIVITY OF SEMICONDUCTORS BY THE FOUR PROBES METHOD. S.V.Airepetyants and M.S.Bresler.
Fiz. tverdogo Tela, Vol. 1, No. 1, 152-3 (1959). In Russian.

Formulae are derived for calculating the main values of the electrical conductivity tensor (σ_x, σ_y, σ_z) from data obtained by the four probes method on specimens that need be only 2 to 3 times larger than the distance between the probes. Formulae for calculating the corrections due to finite dimensions of the specimens are given in a modified form, applicable to anisotropic materials. M.H.Sloboda

539.2 : 537.311

573 ON THE RELATIONSHIP BETWEEN ENERGETIC, ELECTROPHYSICAL AND MECHANICAL PROPERTIES OF SEMICONDUCTORS. B. F. Ormont.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 1, 129-32 (Jan. 1, 1959). In Russian.

Various relationships are derived linking energy of atomization, specific surface energy, microhardness and energy gap (Eg) of a binary semiconducting compound. It is argued that electronegativity differences alone cannot account for the sharp increase in Eg on going from Group IV elements to $A^{III}B^{V}$ and $A^{II}B^{VI}$ compounds, and expressions are given in which Eg is proportional to $(V_B/V_A)^{1.2}$ — where V_A and V_B are the numbers of valence electrons belonging to A and B atoms — as well as to functions of ionic, covalent and metallic bonding contributions. It is concluded that for compounds with the same electronegativity difference Eg is highest for the largest B and smallest A atoms. Predicted values of Eg for $A^{III}B^{V}$ compounds are mostly in fair agreement with experiment. Agreement for $A^{II}B^{VI}$ and $A^{IV}B^{VI}$ (PbS type) compounds is less good. C. H. L. Goodman

539.2 : 537.311

574 THE RECOMBINATION OF CHARGE CARRIERS IN SEMICONDUCTORS FOR A LARGE TRAP CONCENTRATION. V.D.Egorov.
Fiz. tverdogo Tela, Vol. 1, No. 5, 832-3 (May, 1959). In Russian.

Discusses the case of concentrations N^+ and N^- of hole and electron traps of the same order, but much larger than the concentration of majority carriers. The current attenuation constants are $\lambda_1 = C_nN^+$ and $\lambda_2 = C_pN^-$ (C_n and C_p are the capture coefficients). C_n and C_p should be determinable from the decrease of photoconductivity

$$\delta o = Ae^{-\lambda_1 t} + Be^{-\lambda_2 t}$$

in doped germanium. R.Berman

539.2 : 537.311

575 THE DETERMINATION OF THE EFFECTIVE MASS OF CARRIERS AND THE OPTICAL CONSTANTS OF SEMICONDUCTORS. V.P.Silin.
Fiz. tverdogo Tela, Vol. 1, No. 5, 705-8 (May, 1959). In Russian.

The problem of the experimental determination of the mass of carriers in semiconductors is examined from the theoretical Fermi-liquid approach. K.N.R.Taylor

539.2 : 537.311

576 CHARACTERISTIC TIMES OF THE STEADY-STATE ELECTRONIC PROCESSES IN SEMICONDUCTORS.

I.M.Guro.

Iz. tverdogo Tela, Vol. 1, No. 1, 3-12 (1959). In Russian.

Theoretical. A solution of a set of equations of the kinetics of steady-state electronic processes taking place under conditions of non-uniform generation was obtained. It was shown that in this case bipolar diffusion, determined by the bipolar diffusion coefficient D and the characteristic time τ_0 takes place, the diffusion length of this type being independent from the concentration of the adhesion centres. It was shown also that, since the volume charge formed under the conditions of non-uniform steady-state generation is determined not only by the difference between the electron and hole mobilities but also by the capture of the minority carriers by the adhesion and recombination centres, it can be either positive or negative, while for given conditions of charging of these centres it can be zero.

M.H.Sloboda

539.2 : 537.311

577 THE SPIN MECHANISM OF THE RECOMBINATION OF CURRENT CARRIERS IN FERROMAGNETIC SEMICONDUCTORS. V.L.Bonch-Bruevich.

Fiz. tverdogo Tela, Vol. 1, No. 2, 186-91 (Feb., 1959). In Russian.

The possibility of the recombination of current carriers by a process in which the liberated energy is absorbed by spin waves is discussed, and the mechanism of this process is analytically studied. The order of the magnitude of the capture cross-section is evaluated, and expressions are derived which describe the relationship between the recombination coefficient and temperature, degree of magnetization at the saturation point, and material parameters.

M.H.Sloboda

539.2 : 537.311

578 THE EXTRINSIC CONDUCTIVITY IN LIQUID AND AMORPHOUS SEMICONDUCTORS. I.Z.Fisher.

Fiz. tverdogo Tela, Vol. 1, No. 2, 192-4 (Feb., 1959). In Russian.

Theoretical. The magnitude of the fluctuations of the intermolecular electric field in liquids and glasses is analytically determined and it is concluded that the formation of donors and acceptors would be possible only in a hypothetical amorphous medium characterized by a structure only slightly different from that of a crystal and by the free electron path considerably longer than the intermolecular distance.

M.H.Sloboda

539.2 : 537.311

579 ION SCATTERING OF HOT ELECTRONS IN NON-DEGENERATE NON-POLAR SEMICONDUCTORS.

K.Seeger.

Z. Phys., Vol. 156, No. 4, 582-91 (1959). In German.

The theory of carrier heating under the influence of both ion scattering and lattice scattering is developed. Scattering by acoustical and optical phonons is considered. The velocity distribution is chosen as Maxwellian using an electron temperature slightly above the lattice temperature. For n-type germanium the influence of ion scattering on electron heating comes out to be about 4 times stronger than that on zero-field mobility in the case of small ion densities. A factor of 5 is obtained instead, if optical phonons are neglected, using a theory by Sodha (1957). A comparison with experimental data shows that apparently ion scattering is insufficient to explain the variations found between different samples.

539.2 : 537.311

580 THE ELECTRICAL CONDUCTIVITY AND THE HALL EFFECT IN A POLAR SEMICONDUCTOR TAKING INTO ACCOUNT THE SCATTERING OF CURRENT CARRIERS ON THE OPTICAL AND ACOUSTICAL LATTICE VIBRATIONS AND ON IMPURITY IONS. N.N.Porfir'eva.

Fiz. tverdogo Tela, Vol. 1, No. 6, 873-7 (June, 1959). In Russian.

It was found that in a certain range of temperature all the three mechanisms of scattering are present. Results of the calculations are shown graphically.

A.Tybulewicz

539.2 : 537.311

581 DETERMINATION OF AVALANCHE BREAKDOWN IN P–N JUNCTIONS. J.Maserjian.

J. appl. Phys., Vol. 30, No. 10, 1613-14 (Oct., 1959).

The ionization rate per centimetre is expressed by α = a exp.(-b/E) in terms of the electric field E and two constants a and b, different for holes and electrons. The voltage necessary for avalanche breakdown is then found as a function of the impurity concentration by integrating α over the junction width. When this is plotted, using values of a and b obtained from published experimental data for silicon and germanium, it is found to be in good agreement with measurements made by Miller and McKay. Slight modification of the constants a and b, justified by the fact that the original values were obtained by a somewhat arbitrary averaging process, improves the agreement. The method is developed for a step junction and applied to a graded junction, but could be extended to many types of p–n junctions.

I.Cooke

539.2 : 537.311

582 METAL TO SEMICONDUCTOR CONTACTS : INJECTION OR EXTRACTION FOR EITHER DIRECTION OF CURRENT FLOW. N.J.Harrick.

Phys. Rev., Vol. 115, No.4, 876-82 (Aug. 15, 1959).

Metal-to-semiconductor contacts were studied using infrared radiation to measure the current versus added carrier density (J-Δp) characteristics. It is found that the nature of the semiconductor surface rather than the metal is the major factor in controlling the characteristics of the metal to semiconductor contact. Two unusual classes of results are described; viz., where injection into the semiconductor bulk is observed regardless of the direction of current flow and where extraction is observed regardless of the direction current flow. The model proposed to explain these unusual results utilizes an insulating film between the metal and the semiconductor. Two competing effects, voltage controlled injection and extraction, which can explain these results, are discussed. Extraction for either direction of current flow is explained by the occurrence of the field-effect at the metal-to-semiconductor contact. Injection for either direction of current flow is explained by a change, due to the applied voltage, in the communication of the current carriers in metal with the valence and conduction bands of the semiconductor, resulting in a change of the current composition entering the semiconductor. Relaxation effects, which are attributed to the action of slow surface states on the charge induced in the surface barrier, were also observed in the J-Δp characteristics. The predominance of injection after relaxation is thus attributed to a reduction of the magnitude of the field effect through the shielding effect of the charge in the surface states.

539.2 : 537.311 : 621.382

583 SOME EFFECTS OF PULSE IRRADIATION ON SEMICONDUCTOR DEVICES.

W.A.Bohan, J.D.Maxey and R.P.Pecoraro.

Proc. Instn Elect. Engrs, Paper 3124E [International Convention on Transistors and Associated Semiconductor Devices], publ. 1960 (Part B Suppl. No. 15, 361-7).

The effects of pulse irradiation upon majority and minority carrier properties of semiconductor devices are presented, with emphasis on those effects peculiar to radiation rates of the order of 10^{16} neutrons/cm^2 per second and 10^7 röntgens (γ)/sec. Experimental data and semiconductor theory are employed to obtain an expression for the dependence of device parameters on integrated neutron exposure in germanium and silicon. Comparisons are made of the effects produced by neutrons and γ-rays. Experimental data for the transient photovoltaic effect observed in junction devices under pulse irradiation are discussed on the basis of current theory.

539.2 : 537.311

584 DETERMINATION OF THE PRESSURE (UP TO 10 000 KG/CM^2) DEPENDENCE OF THE HALL EFFECT IN N-TYPE GERMANIUM. A.I.Likhter and T.S.D'yakonova.

Fiz. tverdogo Tela, Vol. 1, No. 1, 95-103 (1959). In Russian.

With the aid of a specially designed apparatus the effect of hydrostatic pressure (0-10 000 kg/cm^2) on the Hall effect and resistivity of n-type, Sb-doped, 4.5 and 13 ohm cm Ge specimens was studied at temperatures between −70 and +100° C. At temperatures at which the resistivity of the specimens increased with temperature, the Hall effect decreased with increasing pressure; in the intrinsic conductivity range (where resistivity decreases with temperature) the effect of pressure was opposite.

M.H.Sloboda

539.2 : 537.311

585 DEPENDENCE OF THE HALL EFFECT ON PRESSURE IN P-GERMANIUM OF 50 OHM CM RESISTIVITY.

A.I.Likhter.

Fiz. tverdogo Tela, Vol. 1, No. 6, 895-8 (June, 1959). In Russian.

In the impurity conduction region (1-10° C) the positive Hall e.m.f. rises sublinearly with pressure from atmospheric to 10 000 kg/cm^2. In the mixed conduction region (25-46° C) increase

of pressure reverses the Hall e.m.f. sign, which is negative at atmospheric pressure. On transition into the intrinsic conduction region (above 50° C) the Hall e.m.f. curves have minima when plotted against pressure. At still higher temperatures (over 65° C) the Hall e.m.f. is negative and its absolute value rises with pressure. The pressure dependence of the electrical resistance was also obtained at various temperatures and when combined with the pressure dependence of the Hall e.m.f. it yielded the pressure dependence of the Hall mobility. In the intrinsic conduction region this mobility is proportional to the difference of the electron and hole mobilities and it decreases with pressure. In the hole conduction region (1-10° C) the Hall mobility rises with pressure. Since the Hall mobility between 1 and 10° C is proportional to the hole mobility it follows that the latter also rises with pressure. A.Tybulewicz

539.2 : 537.311

586 THE RELATIONSHIP BETWEEN THE CONDUCTIVITY AND THE ELECTRON DENSITY DISTRIBUTION IN A GERMANIUM CRYSTAL. Yu.N.Shuvalov.
Fiz. tuerdogo Tela, Vol. 1, No. 2, 208-15 (Feb., 1959). In Russian.

X-ray diffraction analysis carried out at room temperature and at 140°C on specimens of various resistivity revealed a marked tendency of the intensity of the beams diffracted from various sets of planes to increase or decrease with increasing conductivity and temperature of the specimens. The observed effect is attributed to redistribution of the electron density in the crystal, and it is postulated that with increasing conductivity of Ge, the electron density along the lines of chemical bonds increases.
M.H.Sloboda

539.2 : 537.311

587 THE EFFECT OF DEFORMATION ON THE ENERGY SPECTRUM AND ELECTRICAL PROPERTIES OF P-TYPE GERMANIUM AND SILICON. G.E.Pikus and G.L.Bir.
Fiz. tverdogo Tela, Vol. 1, No. 1, 154-6 (1959). In Russian.

Theoretical. From a general formula for the hole spectrum in a deformed crystal two expressions for the limiting conditions are derived of which one, almost identical with the Adams formula (Abstr. 3277 of 1957), is valid at a certain distance from the band edge, the other being valid at the band edge. These expressions indicate that at high temperatures the elastoresistance effects are proportional to deformation and are relatively small. At sufficiently low temperatures the electrical properties of a deformed crystal become markedly anisotropic, the degree of anisotropy being unaffected by the degree of deformation and depending only on its direction. M.H.Sloboda

539.2 : 537.311

588 REMARKS ON SOME ELECTRICAL PROPERTIES OF VERY THIN FILMS OF GERMANIUM. C.Uny.
C.R. Acad. Sci. (Paris), Vol. 249, No. 5, 645 (Aug. 3, 1959). In French.

After vacuum evaporation the ageing of the films was observed by measuring the resistance as a function of time. The films were sufficiently stable after about ten hours for the deviations from Ohm's law to be determined. Films of different thicknesses all show the same general behaviour, the resistance decreasing for currents above a few microamperes. D.J.Oliver

539.2 : 537.311

589 THE KINETICS OF ELECTRON EXCHANGE BETWEEN THE SURFACE AND INTERIOR IN GERMANIUM.
A.É.Yunovich.
Fiz. tverdogo Tela, Vol. 1, No. 6, 908-12 (June, 1959). In Russian.

The dependence of field effect on frequency in the range 10^2-10^6 c/s was measured in n- and p-type germanium by a method previously described (Abstr. 7925 of 1958). Frequency dependence of the field effect mobility obeys the relation

$$\mu_{eff} = a + \frac{b\omega^2\tau^2}{1+\omega^2\tau^2}$$

where coefficients a and b are determined by the volume properties of the specimen and by the surrounding atmosphere (dry and moist O_2 and N_2). The relaxation time τ of the field effect agrees with the effective life-time of minority carriers in the specimen. The results are compared with the author's theories and with Garrett's (Abstr. 2302 of 1958). Possibly for each atmosphere one of several levels, determining surface recombination, is dominant.
R Berman

539.2 : 537.311 : 621.315.59

590 THE STATE OF ETCHED SEMICONDUCTOR SURFACES AS REVEALED BY ELECTRON DIFFRACTION.
P.J.Holmes and R.C.Newman.
Proc. Instn Elect. Engrs, Paper 2998E [International Convention on Transistors and Associated Semiconductor Devices], publ. 1960 (Part B Suppl. No. 15, 287-92).

Germanium and silicon (100) and (111) surfaces have been etched with a variety of reagents and subsequently examined by reflection electron diffraction. No oxide layers were detected on surfaces etched with the common mixtures containing hydrofluoric and nitric acids. When metal ions were present, either as essential components or as impurities in the etchants, deposits, either of the metals or of compounds, were sometimes found; in particular, contamination from materials commonly used for making contacts to devices has been found. No preferential deposition was found on either side of an etched p–n junction. Details of the sensitivity of electron diffraction are included as an appendix.

539.2 : 537.311

591 CONTRIBUTION TO THE STUDY OF THE RECOMBINATION OF EXCESS CARRIERS IN GERMANIUM.
C.Benoit à la Guillaume.
Ann. Phys. (Paris), Ser. 13, Vol.4, No.9-10, 1187-237 (Sept.-Oct., 1959). In French.

Describes the measurement and interpretation of infrared emission spectra taken between 14 and 300° K. The interpretation is based on two competing processes for the recombination of excess carriers: recombination from band to band, and recombination at dislocations. The lines due to recombination at dislocations are separated by a method, which depends on the fact that the intensity-current density relationship is different at a junction. A scheme of energy levels corresponding to dislocations is proposed.
B.T.M.Willis

539.2 : 537.311

592 HOT ELECTRONS AND CARRIER MULTIPLICATION IN SILICON AT LOW TEMPERATURE.
W.Kaiser and G.H.Wheatley.
Phys. Rev. Letters, Vol. 3, No. 7, 334-6 (Oct. 1, 1959).

Measurements of Hall coefficient and resistivity of two silicon samples containing fewer than 10^{16} cm^{-3} atoms of oxygen, were made as a function of electric field at a temperature of 20° K. Four regions of electron behaviour are noted and explained theoretically.
C.A.Hogarth

539.2 : 537.311

593 ON THE TEMPERATURE DEPENDENCE OF THE CARRIER LIFETIME IN HIGH PURITY SILICON.
M.Zerbst and W.Heywang.
Semiconductors and phosphors. (See Abstr. 9597 of 1959) p. 392-8. In German.

This was measured over the temperature range −60° to +200° C, and by determining the surface recombination velocity separately, the lifetime due to volume recombination was deduced. The results could not be reconciled with the Shockley–Read model of recombination centres, because the curves of lifetime versus temperature did not show the expected change in slope at the transition from extrinsic to intrinsic conduction. K.W.Plessner

539.2 : 537.311

594 THE EFFECT OF AN EXTERNAL ELECTRIC FIELD ON THE SURFACE RECOMBINATION AND CAPACITOR PHOTO E.M.F. OF N-TYPE SILICON. O.V.Snitko.
Fiz. tverdogo Tela, Vol. 1, No. 6, 980-3 (June, 1959). In Russian.

Describes experimental results using thin Si sheets (about 3×10^{-2} cm thick) with an indium contact on one side and a mica sheet 1.2×10^{-3} cm thick separating the other side from a metal electrode. A p.d. of 1500 V was applied to the capacitor thus formed from a constant external source. Graphs show the dark conductivity, speed of surface recombination, and capacitor photo e.m.f. as functions of the Si surface charge. D.E.Brown

539.2 : 537.311

595 A METHOD OF PRODUCING OHMIC CONTACTS WITH SILICON. A.F.Gorodetsky, V.G.Mel'nik and I.G.Mel'nik.
Fiz. tverdogo Tela, Vol. 1, No 1, 173-4 (1959). In Russian.

A Ge layer is deposited in vacuo at 550° C on the Si specimen etched with a 50/50 HF/HNO_3 solution; the assembly is then heated in vacuo to 700-750° C after which a layer of Ni is electrodeposited on Ge. Ge (p-type) and Ge alloyed with 1-2% Sb are used for p- and

-type Si, respectively. Very low resistance, good mechanical roperties and high stability of contacts made in this way are attributed to mutual solid solubility and identical crystal structure of Si nd Ge. M.H.Sloboda

539.2 : 537.311

596 A COMPARISON OF THE THEORY OF IMPACT IONIZATION WITH MEASUREMENTS ON SILICON P–N UNCTIONS. F.W.G Rose.

Electronics and Control, Vol. 6, No. 1, 70-3 (Jan., 1959).

Shows that the shape of the reverse current–voltage curves ound by Herlet and Patalong (Abstr. 9664 of 1955) for n^+p junctions nd by the author's laboratory for a p^+n junction, can be explained, n the region between the low-voltage saturation current and the high-oltage avalanche current, in terms of Armstrong's equations (Abstr. 995 of 1958) for impact ionization, assuming that $U_i/\lambda = 7.6 \times 10^5$ V/cm, here U_i is the energy threshold for pair production and λ is the ean free path of electrons or holes. The omission of a λ in rmstrong's paper is pointed out. F.F.Roberts

539.2 : 537.311

597 STUDY OF THE PREPARATION OF N–P JUNCTIONS BY THE DIFFUSION OF BORON AND PHOSPHORUS NTO SILICON. G.Feuillade.

. Chim. phys., Vol. 56, No. 6, 593-608 (June, 1959). In French.

The diffusion of boron and phosphorus into silicon is of great mportance in transistor technology. Although idealized theory enbles an approximate understanding and design of processes to be chieved, actual technical conditions are somewhat different from hose assumed in simple theory. This paper reports a very careul investigation of the processes, paying particular attention to urface concentrations, surface structure and pre-treatment, and he mode of transport of the diffusant. C.A.Hogarth

539.2 : 537.311

598 ELECTRICAL PROPERTIES OF N-TYPE AlSb. D.N.Nasledov and S.V.Slobodchikov.

iz. tverdogo Tela, Vol. 1, No. 5, 748-54 (May, 1959). In Russian.

The electrical conductivity, the Hall constant and the differential hermoelectric power of n-type AlSb with Te and Se impurities were easured at temperatures between 80° and 1200° K. From these the urrent-carrier mobility was deduced to be 5-50 $cm^2 V^{-1} sec^{-1}$. At igh temperatures the mobility varied with temperature according o T^{-k}, where k = 1.4-1.6 (this indicates carrier scattering mainly n the thermal vibrations of the lattice). At low temperatures, region of degeneracy was observed. The mean effective carrier ass was 1.2 m_0. The activation energy was 0.13 eV in AlSb with e and 0.27 eV in AlSb with Se. In the intrinsic conduction region he activation energy was the same as in p-type AlSb.

A.Tybulewicz

539.2 : 537.311

599 CONDUCTIVITY AND PHOTOCONDUCTIVITY OF ANTIMONY TRISELENIDE LAYERS. B.T.Kolomiets, V.M.Lyubin and D.V.Tarkhin.

Fiz tverdogo Tela, Vol. 1, No. 6, 899-902 (June, 1959). In Russian.

The temperature dependence of the dark and photoconductivities, he spectral distribution of the photocurrent and the absorption pectrum (400-800 mμ) were obtained for the Sb_2Se_3 layers. These ayers were prepared by evaporation in vacuo (0.5-1.5 μ thickness) sing materials of various degrees of purity. It was found that the roperties were not affected by the degree of purity and that the dark esistivity of these layers was higher compared with the same proerty of monocrystals and polycrystalline samples. A.Tybulewicz

539.2 : 537.311

600 CONDUCTIVITY FLUCTUATIONS IN SOLID AND LIQUID Sb_2S_3. M.I.Kornfel'd and L.S.Sochava.

Fiz. tverdogo Tela, Vol. 1, No. 9, 1366-9 (Sept., 1959). In Russian.

Excess noise in solid Sb_2S_3 was measured and found to be roportional to the applied d.c. voltage at small voltages and inversely proportional to the frequency; the temperature dependence etween 180° and 550° C was found to be exponential, similar to the esistivity. The noise of the liquid state was smaller than could e measured with the apparatus used. D.J.Huntley

539.2 : 537.311

601 PROPERTIES AND STRUCTURE OF TERNARY SEMICONDUCTOR SYSTEMS. VI. ELECTRICAL AND PHOTOELECTRIC PROPERTIES OF Sb_2S_3–Bi_2S_3 LAYERS. B.T.Kolomiets and V.M.Lyubin.

Fiz. tverdogo Tela, Vol. 1, No. 5, 740-7 (May, 1959). In Russian.

For previous work, see Abstr. 3486 (1959). The layers (0.5-4 μ thick) were prepared by evaporation in vacuo. Their V–I characteristics (Ohm's law was obeyed), dark resistance at temperatures from room to 400° C, and spectral distribution of photoconductivity were recorded. It was found that heating to temperatures above 200-220° C reduces the resistance of the layers irreversibly by a factor of 2-3 and makes then opaque. A.Tybulewicz

539.2 : 537.311

602 STUDIES OF THE GROWTH OF AN ELECTRONIC SEMICONDUCTOR LAYER AT THE CONTACT OF CADMIUM WITH SELENIUM.
V.A.Dorin, B.I.Kuznetsov and D.N.Nasledov.
Fiz. tverdogo Tela, Vol. 1, No. 5, 734-9 (May, 1959). In Russian.

Growth of a layer of cadmium selenide at the contact of cadmium with selenium was investigated at temperatures from 240° to 300° C. It was found that at 300° C the square of the layer thickness is directly proportional to time. The heat of dissociation of the cadmium selenide lattice was found to be 31 000 ± 1000 cal/mole. The results are applicable to the layers in selenium rectifiers. A.Tybulewicz

539.2 : 537.311

603 Cd_3As_2 — A NONCUBIC SEMICONDUCTOR WITH UNUSUALLY HIGH ELECTRON MOBILITY.
A.J.Rosenberg and T.C.Harman.
J. appl. Phys., Vol. 30, No. 10, 1621-2 (Oct., 1959).

The authors report a Hall mobility for Cd_3As_2 at 300° K of 10 000 cm^2/volt -sec when the carrier concentration is $4 \times 10^{18}/cm^3$. This is higher than the values reported for any other material, including InSb, InAs, HgSe, and HgTe. The compound under discussion is described as a coordination compound semiconductor with a tetragonal $D5_9$ structure, in striking contrast with the cubic zincblende structure characteristic of the other four high mobility semiconductors. A Hall mobility as high as 36 000 cm^2/volt-sec is reported for these polycrystallite samples of Cd_3As_2 at 78° K. I.Cooke

539.2 : 537.311

604 INVESTIGATION OF THE INTERCRYSTAL ENERGY BARRIERS IN THIN CdS LAYERS BY MEANS OF BOMBARDMENT WITH LOW-ENERGY ELECTRONS.
Li Chzhi-tszyan' [Li Chih-tsien].
Fiz. tverdogo Tela, Vol. 1, No. 1, 82-8 (Jan., 1959). In Russian.

The effect of irradiation with 0-15 eV electrons on the electrical resistance of very thin (10^{-7}-10^{-5} cm) CdS layers was studied. It was found that above a certain critical electron energy E_c the resistance of CdS layers fell after electron irradiation, while below E_c electron irradiation increased the resistance. The value of E_c decreased with increase of thickness of the layers, but it was independent of thickness in the case of layers thicker than 3×10^{-5} cm. After heating to 300° C or a higher temperature the value of E_c rose or became indeterminate. Illumination of CdS layers with blue light (4800 A) raised the value of E_c, indicating anisotropy of CdS crystallites; illumination with light of 6500 A wavelength did not affect the value of E_c very greatly. Increase of the resistance on electron irradiation was ascribed to attachment of electrons at the crystallite surfaces in the layers. The resistance was lowered by electrons with energies higher than E_c because such electrons were able to penetrate or lower the intercrystalline energy barriers and increase in this way the electron density inside the crystallites. CdS layers thinner than 3×10^{-5} cm were found to consist of separate grains which joined together in thicker layers. A.Tybulewicz

539.2 : 537.311

605 ELECTRON ENERGY DEPENDENCE OF INDUCED CONDUCTIVITY OF CADMIUM SULPHIDE AND CADMIUM SELENIDE FILMS BOMBARDED WITH SLOW ELECTRONS. Li Chzhi-Tszyan' [Li Chih-Tsien].
Fiz. tverdogo Tela, Vol. 1, No. 1, 77-81 (1959). In Russian.

The variation of electrical conductivity of vacuum-deposited CdS and CdSe films approximately 10^{-4} cm thick, bombarded with 0-15 eV electrons was studied. With increasing electron energy the induced conductivity increased in steps, the energy increment necessary to produce each consecutive rise of conductivity being approximately 2.5 eV for CdS and 1.8 eV for CdSe. This was taken to indicate that the induced conductivity was associated with electrons excited from the filled to the conductivity band. M.H.Sloboda

539.2 : 537.311

606 THE COMPOSITION, RESISTIVITY, AND THERMOELECTRIC POWER OF CERIUM OXIDES BELOW 500°C.

A.W.Czanderna and J.M.Honig.

J. Phys. Chem. Solids, Vol. 6, No. 1, 96-7 (July, 1958).

CeO_2 was subjected to heating cycles and the mass loss found to correspond to one atom of oxygen per surface unit cell. No interpretation of the resistivity and thermoelectric power data is given.

D.J.Huntley

539.2 : 537.311

607 DOPING OF THE SEMICONDUCTING COMPOUND COBALT ANTIMONIDE.

L.D.Dudkin and N.Kh.Abrikosov.

Fiz. tverdogo Tela, Vol. 1, No. 1, 142-51 (1959). In Russian.

The effect of Cu, Zn, Al, Ti, Si, Ge, Sn, Pb, Bi, Se, and Te additions on the thermal and thermoelectric properties of CoSb was studied. Only four of these elements were found to be "active": Fe and Ni replacing Co in the ϵ-phase, and Sn and Te replacing Sb. The Ni and Te atoms act as donors, fully ionized at room temperature; Sn is an acceptor. Fe reduces the lattice component of thermal conductivity of CoSb and stabilizes the defective crystal lattice of the ϵ-phase. The experimental results indicated that the first criterion in selecting "active" doping additions for semiconducting compounds is the solid solubility of the former in the latter; this, in the case of electron semiconductors characterized by predominantly covalent bonds, is determined by the ability of the atoms of the alloying addition to form bonds identical with those formed by the element which is being replaced, and by the difference in size of the mutually replaceable atoms.

M.H.Sloboda

539.2 : 537.311

608 THE NERNST–ETTINGSHAUSEN EFFECT IN GALLIUM ARSENIDE.

O.V.Emel'yanenko and D.N.Nasledov.

Fiz. tverdogo Tela, Vol. 1, No. 6, 985-8 (June, 1959). In Russian.

Experimental curves, reproduced for two samples of n-GaAs in weak magnetic fields (7000 Oe), include the Nernst–Ettingshausen constants as functions of temperature and show qualitative agreement with present thermomagnetic effect theory. It is also seen that at low temperatures ($T < 300$-$400^\circ K$) the basic role in the Nernst–Ettingshausen effect is played by impurity ion diffusion both in non-degenerate and degenerate n-GaAs.

D.E.Brown

539.2 : 537.311

609 ELECTRIC AND GALVANOMAGNETIC PROPERTIES OF HIGH-PURITY InSb.

N.I.Volokobinskaya, V.V.Galavanov and D.N.Nasledov.

Fiz. tverdogo Tela, Vol. 1, No. 5, 755-60 (May, 1959). In Russian.

The electrical conductivity and the Hall effect were investigated at 77-500°K in magnetic fields from 60 to 25 000 Oe. Some anomalies were found in the Hall effect and in the dependence of the conductivity on the transverse magnetic field intensity at low temperatures.

A.Tybulewicz

539.2 : 537.311 : 621.373.5

610 "HOT" ELECTRON EXPERIMENTS IN InSb. APPLICATION TO THE REALIZATION OF AN OSCILLATOR.

J.Bok and R.Veilex.

C.R. Acad. Sci. (Paris), Vol. 248, No. 16, 2300-2 (April 20, 1959). In French.

The conductivity and Hall effect were studied at high electric fields. In material which is only slightly p-type, the creation of hole–electron pairs by collision causes the Hall effect to change sign and this was observed experimentally at 77°K using a pulsed electric field (1 to 10 μsec). The current–voltage characteristic of a bar of such material in a longitudinal field of 1500 G shows a negative resistance region and this has been used with an LC circuit to generate oscillations. Sinusoidal oscillations were obtained in the range from 5 to 30 Mc/s and also at 1200 Mc/s. Besides this, oscillations arising from some other mechanism were observed at lower electric fields of the order 40 V/cm.

W.Bardsley

539.2 : 537.311

611 CERTAIN PROPERTIES OF [N-TYPE] InSb–GaSb ALLOY. V.I.Ivanov-Omskii and B.T.Kolomeits.

Fiz. tverdogo Tela, Vol. 1, No. 4, 568-9 (April, 1959). In Russian.

Optical and electrical properties were studied. In the region of intrinsic conduction the logarithms of the electrical conductivity and the Hall constant were practically independent of 1/T, where T is the absolute temperature. The optical absorption edge near 3μ shifted towards longer wavelengths with increase of temperature and from this the authors deduced the rate of change of the forbidden-bandwidth (ΔE) with temperature to be -4.5×10^{-4} eV/deg. The value of ΔE at room temperature, deduced from optical measurements, was 0.33 eV and at 0°K it was 0.45 eV, as deduced from electrical measurements. Above room temperature the electron mobility varied as $kT^{-1.3}$, where k is a constant.

A.Tybulewicz

539.2 : 537.311 : 621.382.22

612 STUDY OF RECTIFYING CHARACTERISTICS OF FeS_2 AND GERMANIUM POINT CONTACT RECTIFIERS.

J.N.Das.

Indian J. Phys., Vol. 31, No. 3, 172-4 (March, 1957).

Values of the "contact potential difference" ϕ, the spreading resistance R_S and the logarithmic slope coefficient α, all apparently derived from the static characteristics, are given for some experimental point contacts on FeS_2 and for some commercial Ge point contact diodes.

F.F.Roberts

539.2 : 537.311

613 THE EFFECT OF PRESSURE (UP TO 30 000 ATM) ON THE ELECTRICAL CONDUCTIVITY OF SELENIUM. I.

P.T.Kozyrev.

Fiz. tverdogo Tela, Vol. 1, No. 1, 104-12 (1959). In Russian.

The conductivity σ of mono- and poly-crystalline Se specimens, subjected to various pressures P was measured at various temperatures. Consistent results were obtained for single crystals, the σ versus P relationship in the 5000-30 000 atm range being approximately exponential. The log σ versus P graph between 14 000 and 25 000 atm was a straight line, its slope decreasing with increasing temperature. The room temperature resistivity of single crystals, measured along the c-axis at P = 5000 and 29 000 atm, was 4000 and 40 ohm cm, respectively.

M.H.Sloboda

539.2 : 537.311

614 THE EFFECT OF PRESSURE ON THE ELECTRICAL CONDUCTIVITY OF OXYGEN-FREE SELENIUM. II.

P.T.Kozyrev.

Fiz. tverdogo Tela, Vol. 1, No. 1, 113-23 (1959). In Russian.

Methods of refining and de-oxidizing Se are described. Removal of oxygen from polycrystalline Se resulted in its resistivity increasing from 10^4-10^5 to approximately 10^8 ohm cm. The thermo-e.m.f. of oxygen-free Se at 18°C was 40 mV (deg C)$^{-1}$ higher than that of the oxygen-bearing material. The relationship between the electrical conductivity σ of oxygen-free Se and pressure P was approximately exponential. The slope of the log σ versus P curves, which at P = 14 000 to 25 000 atm constituted straight lines, decreased with rising temperature at low temperatures and increased at high temperatures. The increase of σ of oxygen-bearing Se due to increased P was attributed to the variation of the hole mobility.

M.H.Sloboda

539.2 : 537.311

615 CONDUCTIVITY FLUCTUATIONS IN AMORPHOUS SEMICONDUCTORS. M.I.Kornfel'd and L.S.Sochava.

Fiz. tverdogo Tela, Vol. 1, No. 9, 1370-1 (Sept., 1959). In Russian.

The excess noise of two amorphous semiconductors Tl_2Te–As_2Te_3 and Tl_2Se–As_2Te_3 was found to be smaller than could be measured, being overridden by thermal noise. At the maximum d.c. current of 3 mA used, the excess noise was at least four times less than thermal noise. It is suggested that the lack of excess noise may be connected with the absence of certain macroscopic heterogeneities, such as grain boundaries, normally found in crystalline semiconductors.

D.J.Huntley

Photoconductivity

539.2 : 537.311 : 621.382

616 A NOTE ON THE USE OF FILTERS IN PHOTOCONDUCTIVE DECAY MEASUREMENTS. A.C.Sim.

Proc. Instn Elect. Engrs, Paper 2885E [International Convention on Transistors and Associated Semiconductor Devices], publ. May, 1959 (Part B Suppl. No. 15, 308-10, 329-30).

Republication, with discussion, of the paper abstracted in Abstr. 4573 (1959).

539.2 : 537.311

617 THE INFLUENCE OF SURFACE RECOMBINATIONS ON PHOTOCONDUCTIVITY OF SEMICONDUCTORS.

G.L.Bir.

Fiz. tverdogo Tela, Vol. 1, No. 1, 67-76 (1959). In Russian.

Theoretical. While the effective rate of surface recombination ch is independent from the mode of carrier generation can be en into account when calculating photoconductivity in the presence hin layers of volume charge, this is not always permissible when k, or so called "diffusion" layers of volume charge are present. e conditions are determined under which it is permissible to make of the effective rates of surface recombination — independent m the mode of carrier generation — in the presence of the ffusion" layers, and the photoconductivity is calculated of semi-ductors (taking into account the surface recombinations and the face electric field) for the case when these conditions are not isfied. It was shown that photoconductivity and its spectral racteristics can be substantially affected by the extent of surface combination and by the properties of the surface barrier; this ld explain the effect of surface preparation on photoconductivity.
M.H.Sloboda

539.2 : 537.312

618 GAIN BAND-WIDTH PRODUCT OF PHOTOCONDUCTORS. R.W.Redington.
ys. Rev., Vol. 115, No. 4, 894-6 (Aug. 15, 1959).

The relaxation time of a photoconductor with space-charge-ited dark current is shown to be less than or equal to the transit e under space-charge-limited current conditions for an arbitrary tribution of impurity levels. Thus the gain band-width product of hotoconductor with space-charge-limited dark current is always s than or equal to the reciprocal of the relaxation time. This lusion of arbitrary impurity levels in the derivation gives a firm er limit for the gain band-width product in the space-charge-ited dark current region. Rose and Lampert concluded that er some conditions this performance in the space-charge-ited current region could be exceeded. The difference between se two conclusions results entirely from a different choice of asure of the relaxation time. The arguments presented suggest t most photoconductors with space-charge-limited dark current sely approach this maximum performance. In addition, a relation ween the variation with light level of the photocurrent, relaxation e, and response time is noted and its usefulness in predicting performance of photoconductors is suggested.

539.2 : 537.312 : 548.5

619 PREPARATION OF PbS PHOTOCONDUCTORS BY CHEMICAL PRECIPITATION.
Va.Berlaga, F.T.Novik and L.P.Strakhov.
. tverdogo Tela, Vol. 1, No. 6, 995-6 (June, 1959). In Russian.

Describes a method of obtaining photoconductive layers of PbS chemical reaction at room temperature, using lead acetate, thio-ea and sodium hydroxide. The layers so obtained are photosens-ve in the visible spectrum, with peak sensitivity at about 0.65 μ resistivity in the order 10^4-10^5 ohm cm; both photosensitivity resistivity depend on the alkali concentration. The photo-rrent is found to depend approximately on the square root of the mination intensity.
V.V.Zakharov

539.2 : 537.312

620 PHOTOCONDUCTIVITY OF Sb_2Se_3.
B.T.Kolomiets and A.Kh.Zeinally.
z. tverdogo Tela, Vol. 1, No. 6, 979-80 (June, 1959). In Russian.

Sb_2Se_3 monocrystals were prepared by zone melting from pure aterials. Their electrical conductivity was 5×10^{-7} ohm^{-1} cm^{-1}. e temperature dependence of the conductivity showed that the nocrystals were intrinsic semiconductors at room temperature. eir thermoelectric power was positive. Photosensitivity of the nocrystals was much higher than that of Sb_2Se_3 layers and poly-ystals. The spectral distribution of photosensitivity between 400 d 1200 mμ of polycrystalline and monocrystalline Sb_2Se_3 had two axima, one at 0.5-0.6 μ and the other at 1.0 μ.
A.Tybulewicz

539.2 : 537.312 : 548.5

621 THE PREPARATION OF MIXED CdS–CdTe MONOCRYSTALS AND SOME OF THEIR CHARACTERISTICS.
I.Vitrikhovskii and I.B.Mizetskaya.
z. tverdogo Tela, Vol. 1, No. 6, 996-9 (June, 1959). In Russian.

Describes the preparation of a new form of mono-crystalline miconductor with a maximum content of 3.5% CdTe, having a xagonal lattice with parameters a = 4.13 A, c = 6.79 A, close to e pure CdS lattice. The maximum photocurrent is shifted to nger wavelengths (λ_m = 5500 A) compared with pure CdS (for which = 5100 A), the amount of the shift being proportional to the per-ntage content of CdTe.
D.E.Brown

539.2 : 537.312 : 621.383

622 USE OF SURFACE - BARRIER PHOTODIODES AS FAST RESPONSE PHOTOCAPACITORS.
E.Ahlstrom, W.G.Matthei and W.W.Gärtner.
Rev. sci. Instrum., Vol. 30, No. 7, 592-3 (July, 1959).

Photocapacitors consisting of gold or silver films on n-type silicon can be made with time constants of 10 mμsec. and areas of 1 mm^2. Present cells are noisy and have low Q-values but improvements are under way. The application of these components to photodetection by the parametric amplifier principle is discussed.
D.J.Oliver

Thermoelectric Properties

539.2 : 537.32

623 THERMOELECTRIC PROPERTIES OF GALLIUM ANTIMONIDE (GaSb). A.I.Blum.
Fiz. tverdogo Tela, Vol. 1, No. 5, 766-73 (May, 1959). In Russian.

The thermoelectric properties of GaSb of various degrees of purity were studied between −190° and +600°C. Using the theory of non-degenerate atomic semiconductors the electron and hole densities and mobilities and the effective carrier masses were calculated in the impurity conduction region. A formula is given which related the thermoelectric power with the forbidden bandwidth and with the ratio of the carrier mobilities. The value of the latter ratio was calculated in the intrinsic conduction region.
A.Tybulewicz

539.2 : 537.32

624 INVESTIGATION OF THE THERMOELECTRIC PROPERTIES OF InSb AND GaSb IN THE MELTING REGION AND IN THE LIQUID STATE. A.I.Blum and G.P.Ryabtsova.
Fiz. tverdogo Tela, Vol. 1, No. 5, 761-5 (May, 1959). In Russian.

The thermoelectric power falls sharply and the electrical conductivity rises sharply at the melting points of both compounds. At the melting point the ratio of the thermoelectric powers in the solid and liquid states (P_S/P_l) is 8 for InSb and 2.3 for GaSb. Purification increases the value of P_S/P_l; for InSb, P_l = 35 μV/deg C at temperatures up to 700° C, and for GaSb the thermoelectric power at the melting point is 35-40 μV/deg C and it falls with further rise of temperature, reaching 20-30 μV/deg C at 825° C. All the thermoelectric powers quoted are negative. The above results are taken as showing that InSb and GaSb acquire metallic properties on melting.
A.Tybulewicz

Dielectric Properties

539.2 : 537.2

625 DIELECTRIC RELAXATION POLARIZATION AND THE INNER FIELD IN CRYSTALS AND POLYCRYSTALS.
G.I.Skanawi.
Semiconductors and phosphors. (See Abstr. 9597 of 1959), p. 656-73. In German.

It is argued that where the crystal structure of a dielectric is not known in sufficient detail to enable the inner field coefficients to be calculated, valuable information on the nature of the polarizable units may still be obtained from dielectric measurements. The outline of a theory is given which assumes an arbitrary inner field (Lorentz) factor and arrives at a set of Debye equations. Experimental results which have been interpreted in terms of this theory include measurements on hydrogenated castor oil (a wax), pure alkali halide crystals and ceramics in the strontium titanate/bismuth titanate series which show high permittivities without being ferroelectric. Recently discovered electret-like behaviour in titanate dielectrics is also mentioned.
K.W.Plessner

539.2 : 537.2

626 APPLICATION OF THE PHOTODIELECTRIC EFFECT TO THE STUDY OF ELECTRON TRAPS. J.Roux.
Semiconductors and phosphors. (see Abstr. 9597 of 1959) p. 568-70. In French.

The author has attempted to find the effect of the introduction of "killer" centres on the electron traps in ZnS(Cu). The technique used was to observe the photodielectric effect and calculate the inter-trap barrier height from the observed critical frequency in the dispersion region. For non-poisoned ZnS(Cu) he finds a barrier height of 0.12 eV and deduces a value of 0.26 eV for that of ZnS(Cu,Co), agreeing with other authors that the introduction of Co increases the effective trap depth.
I.Cooke

539.2 : 537.2

627 DIELECTRIC PROPERTIES OF SEMICONDUCTORS.
H.Rabenhorst and J.Raab.
Ann. Phys. (Leipzig), Folge 7, Vol. 4, No. 5-8, 352-9 (1959). In German.

Measurements of capacitance and loss tangent were made at 100 and 400 kc/s, between −180 and +40°C, on microcrystalline selenium and on single crystals of germanium and silicon. In Ge a steadily increasing tanδ with respect to temperature was observed, but the other two materials gave maxima in tanδ, and it was concluded that high resistance contact layers were falsifying the results. An estimate of the effects caused by such layers is made.

K.W.Plessner

539.2 : 537.22

628 DISPERSION MEASUREMENTS ON NaCl, KCl AND KBr AT WAVELENGTHS BETWEEN 0.3 AND 3 mm.
L.Genzel, H.Happ and R.Weber.
Z. Phys., Vol. 154, No. 1, 13-18 (1959). In German.

The permittivity was measured, using parallel plates and from this the absorption coefficient curve was determined. The formula given by Czerny was extended by the addition of a term covering the infrared range.

V.G.Welsby

539.2 : 537.2

629 THE POLARIZATION MECHANISM IN $Pb_3NiNb_2O_9-Pb_3MgNb_2O_9$.
G.A.Smolenskii, A.I.Agranovskaya and S.N.Popov.
Fiz. tverdogo Tela, Vol. 1, No. 1, 167-8 (Jan., 1959). In Russian.

$Pb_3NiNb_2O_9$ and $Pb_3MgNb_2O_9$ form a continuous series of solid solutions. When the $Pb_3MgNb_2O_9$ component predominates these solid solutions are ferroelectrics (ϵ from 6000 to 13 000 with typical ferroelectric hysteresis loops). Dielectric properties of the solid solutions rich in $Pb_3NiNb_2O_9$ indicate a relaxation polarization mechanism (ϵ over 2000, hysteresis curves without a saturation region).

A.Tybulewicz

539.2 : 537.2

630 DIELECTRIC POLARIZATION AND PIEZOELECTRIC PROPERTIES OF CERTAIN FERROELECTRIC SOLID SOLUTIONS BASED ON SODIUM NIOBATE.
V.A.Isupov and V.I.Kosyakov.
Fiz. tverdogo Tela, Vol. 1, No. 6, 929-34 (June, 1959). In Russian.

Dielectric polarization (in weak and strong fields) and piezoelectric properties of solid solutions of barium, strontium and lead metaniobates in sodium niobate were studied. Certain compositions in the system sodium niobate–lead metaniobate were found to possess high values of the piezoelectric parameter d_{31}/ϵ, stable in a wide range of temperatures. Piezoelectric parameters of solid solutions of strontium metaniobate in sodium niobate have low values, but they are stable in a wide range of temperatures. Dielectric hysteresis loops were observed in polycrystalline samples of sodium niobate at −196°C.

A.Tybulewicz

539.2 : 537.2

631 DIELECTRIC POLARIZATION OF SOLID SOLUTIONS IN THE $(Ba,Sr)(Ta,Nb)_2O_6$ SYSTEM.
G.A.Smolenskii, V.A.Isupov and A.I.Agranovskaya.
Fiz. tverdogo Tela, Vol. 1, No. 6, 992-5 (June, 1959). In Russian.

In solid solutions of the $(Ba,Sr)(Ta,Nb)_2O_6$ system both ferroelectric and relaxation processes of polarization were found to coexist. The ferroelectric state had a Curie region of temperatures rather than a Curie point and it predominated in solid solutions with little or no tantalum. The peak permittivity of $Ba_{0.5}Sr_{0.5}Nb_2O_6$ was ~3300 at ~80°C, while the permittivity of $Ba_{0.5}Sr_{0.5}(Ta_{0.4}Nb_{0.6})_2O_6$ had a very flat peak near 160°C (ϵ ~ 700).

A.Tybulewicz

539.2 : 537.2

632 LONGEVITY OF TECHNICAL DIELECTRICS WORKING IN HIGH-FREQUENCY FIELDS. A.T.Alad'ev.
Fiz. tverdogo Tela, Vol. 1, No. 6, 935-8 (June, 1959). In Russian.

High-frequency electric fields ionize gases included in the pores in technical materials. Heat is then evolved at these pores and thermal stresses so produced may exceed the ultimate strength of the material, leading to mechanical failure of the dielectric. The author shows that, under such conditions, longevity of dielectrics is given by $\tau = A \exp(-\gamma F^3 f)$, where A and γ are constants, F and f are the electric field intensity and frequency respectively. This relationship was found to be obeyed by some Soviet ceramic capacitors for values of τ from several seconds to several thousand hours.

A.Tybulewicz

539.2 : 537.2

633 DIELECTRIC, PIEZOELECTRIC AND ELASTIC PROPERTIES OF SINGLE CRYSTAL RESORCINOL.
V.A.Koptsik.
Kristallografiya, Vol. 4, No. 2, 219-22 (March-April, 1959).
In Russian.

Resorcinol is orthorhombic, belonging to class 2m. The 5 piezoelectric constants and the pyroelectric constant were determined statically. The 3 dielectric constants were measured at room temperature using a capacity bridge. The 9 elastic compliances were measured by a resonance method; values of the elastic stiffnesses are also tabulated.

R.F.S.Hearmon

539.2 : 537.2

634 DIELECTRIC, PIEZOELECTRIC AND ELASTIC PROPERTIES OF CANCRINITE CRYSTALS.
V.A.Koptsik and I.B.Kobyakov.
Kristallografiya, Vol. 4, No. 2, 223-5 (March-April, 1959).
In Russian.

Cancrinite has the composition $(Na_2Ca)_4(AlSiO_4)_6CO_3.H_2O_{0-3}$, and probably belongs to the symmetry group 6 m. The 2 dielectric constants, the 3 piezoelectric constants and the 5 elastic constants were determined by dynamic methods, and the values are tabulated.

R.F.S.Hearmon

539.2 : 537.2

635 THE EFFECT OF ALTERNATING ELECTRIC FIELDS ON THE FORMATION OF ELECTRETS. F.I.Polovikov.
Fiz. tverdogo Tela, Vol. 1, No. 5, 783-8 (May, 1959). In Russian.

Paraffin wax, naphthalene, sulphur, Perspex and ebonite were used. It was found that the consecutive application of alternating and direct (constant) fields often produces more stable electrets and sometimes reverses the direction of polarization.

A.Tybulewicz

539.2 : 537.2

636 A NEW GROUP OF FERROELECTRICS (WITH LAYERED STRUCTURE).
G.A.Smolenskii, V.A.Isupov and A.I.Agranovskaya.
Fiz. tverdogo Tela, Vol. 1, No. 1, 169-70 (Jan., 1959). In Russian.

$PbBi_2Nb_2O_9$ samples were produced by firing at 1000°C for one hour. They had the same structure as $CaBi_2Nb_2O_9$ and were ferroelectric. Their 500 kc/s permittivity rose with temperature from about 100 at 20°C to a peak of about 1100 at 525°C; the loss-angle tangent at 1 kc/s and 20°C was 0.012. No hysteresis loops were observed between 20 and 200°C at fields of 32 kV/cm, but the authors argue that this does not disprove the occurrence of ferroelectricity in $PbBi_2Nb_2O_9$.

A.Tybulewicz

539.2 : 537.2

637 NEW COMPLEX FERROELECTRICS OF THE $A_2^{2+}(B_I^{3+}B_{II}^{5+})O_6$ TYPE. I.
G.A.Smolenskii, V.A.Isupov and A.I.Agranovskaya.
Fiz. tverdogo Tela, Vol. 1, No. 1, 170-1 (Jan., 1959). In Russian.

Samples of (I) Pb_2ScNbO_6 and (II) Pb_2ScTaO_6 were prepared by the usual ceramic technique. Both compounds were ferroelectrics with perovskite structure (scandium, tantalum and niobium ions occupy octahedral positions). Permittivity peaks of the compounds I and II occurred at 90°C (ϵ ~ 2400) and 26°C (ϵ ~ 1400) respectively. At 18°C hysteresis loops were observed in both compounds. Spontaneous polarization of Pb_2ScNbO_6 (determined from the hysteresis loops at 18°C) was 3.6 $\mu C/cm^2$ and its coercive force was 6 kV/cm.

A.Tybulewicz

539.2 : 537.2

638 NEW FERROELECTRICS OF COMPLEX COMPOSITION. III. Pb_2MgWO_6, $Pb_3Fe_2WO_9$ AND Pb_2FeTaO_6.
G.A.Smolenskii, A.I Agranovskaya and V.A.Isupov.
Fiz. tverdogo Tela, Vol. 1, No. 6, 990-2 (June, 1959). In Russian.

For Pt II, see Abstr. 1420 (1959). Pb_2MgWO_6 was prepared by firing at 1000-1050°C (1 hour) and it had perovskite structure. It was found to be an antiferroelectric with a permittivity peak (230) at 38-39°C. $Pb_3Fe_2WO_9$ and Pb_2FeTaO_6 were prepared by firing at 900°C (1 hour) and 1000-1020°C respectively; both had perovskite structure and were ferroelectrics (hysteresis loops at the liquid-oxygen temperature). $Pb_3Fe_2WO_9$ had also antiferromagnetic properties.

A.Tybulewicz

539.2 : 537.2

639 FERROELECTRICITY IN THE PHASE III OF KNO_3.
S.Sawada, S.Nomura and S.Fujii.
J. Phys. Soc. Japan, Vol. 13, No. 12, 1549 (Dec., 1958).

The phase changes on cooling are I-III at 124°C, and III-II at

10°C. On heating, II changes to I at 130°C and III appears only nder high pressure conditions. Hysteresis loops were obtained on ry fused powder cooled slowly to 121°C; the coercive field was 5 kV/cm and the spontaneous polarization 6.3 $\mu C/cm^2$. The per- ittivity rises sharply to about 40 near 130°C, then falls slowly ith rising temperature. Ferroelectricity is ascribed to a shift of e NO_3 group, and phase II may be antiferroelectric. R.C.Kell

539.2 : 537.2

640 BUILT-IN NUCLEATION SITES IN TRIGLYCINE SULFATE. A.G.Chynoweth and J.L.Abel.
. appl. Phys., Vol. 30, No. 10, 1615-17 (Oct., 1959).

For studying domain wall motion in barium titanate, a small imple has been used as a nucleus, the field being locally increased Abstr. 4555 of 1959). In neither dimpled nor wedge-shaped crystals f triglycine sulphate were the desired domain patterns obtained, or were they obtained by reducing the coercivity locally by X-ray ombardment. It appears that the sites for domain nucleation are rimarily determined by singularities built into the crystal during rowth. An unusual domain pattern is described. R.C.Kell

539.2 : 537.2

641 EXPERIMENTS ON THE CRYSTALLIZATION OF NEW PIEZOELECTRIC SUBSTANCES.
..A.Chumakov and V.A.Koptsik.
ristallografiya, Vol. 4, No. 2, 235-8 (March-April, 1959). n Russian.

The chemical formulae, and the solvents from which large rystals can be prepared, are tabulated for 49 new piezoelectric ubstances; if known, the density, melting point and symmetry are lso given. It is suggested that the electrical and elastic constants f 19 of these substances should be measured. R.F.S.Hearmon

OPTICAL PROPERTIES OF SOLIDS

539.2 : 535.32

642 THE REFRACTIVE INDEX OF CADMIUM SULPHIDE. H.Gobrecht and A.Bartschat.
.Phys., Vol. 156, No. 2, 131-43 (1959). In German.

The refractive index (n) was determined by interference ringes from a thin film and double refraction (Δn) measured by a olarization method. Results are shown graphically for the isible spectrum; $n \approx 2.4 - 2.8$; $\Delta n \gtrsim 0.2$, becoming zero near 1100 A. G.F.Lothian

539.2 : 535.34

643 THE TEMPERATURE DEPENDENCE OF THE VISIBLE-LIGHT ABSORPTION COEFFICIENT IN COPPER OXIDE CRYSTALS. I.Pastrnyak.
Fiz. tverdogo Tela, Vol. 1, No. 6, 970-3 (June, 1959). In Russian.

The absorption coefficient of Cu_2O crystals was measured hroughout the visible region and its temperature dependence was ecorded as well. The absorption curves were found to be similar o the photoconductivity curves reported earlier. The results were sed to discuss the mechanism of absorption in this semiconductor nd the origin of the complex structure of the absorption edge, as well as to deduce the energy band scheme for Cu_2O and the tempera- ure dependence of that scheme. A.Tybulewicz

539.2 : 535.34

644 OPTICAL SPECTRUM PRODUCED BY POLARONS IN COPPER OXIDE CRYSTALS.
E.F.Gross and I.Pastrnyak.
Fiz. tverdogo Tela, Vol. 1, No. 6, 973-6 (June, 1959). In Russian.

The explanation of the two steps in the continuous absorption ear the main absorption edge of Cu_2O (Abstr. 5389 of 1953) in erms of excitation of electrons from the valence band to polaron evels. This gives correct frequency and temperature dependence. Objections to other explanations are given. R.Berman

539.2 : 535.33

645 ABSORPTION SPECTRA OF Cr^{3+} IN Al_2O_3. (A). THEORETICAL STUDIES OF THE ABSORPTION BANDS AND LINES. S. Sugano and Y. Tanabe.
J. Phys. Soc. Japan, Vol. 13, No. 8, 880-98 (Aug., 1958).

Within the framework of the crystalline field theory, the excited states of Cr^{3+} in Al_2O_3 and the optical transitions to these states are studied, taking into account the effect of trigonal field and spin–orbit interaction. Initial splittings and optical anisotropies of the broad band (transitions to quartet states) and the sharp lines (transitions to doublet states) are examined. For the sharp lines, the Zeeman effect is also examined and the Zeeman patterns are predicted. Comparing the theoretical results with the experimental ones (following abstract), the assignments of U, Y bands and R_1, R_2, B_1, B_2 lines have been established. It is shown that the g-shifts of the excited doublets observed in the Zeeman patterns can also be explained under such assignments. It is also shown that the experimental data of the optical absorption can be reasonably connected to those of the paramagnetic resonance absorption.

539.2 : 535.33

646 ABSORPTION SPECTRA OF Cr^{3+} IN Al_2O_3. (B). EXPERIMENTAL STUDIES OF THE ZEEMAN EFFECT AND OTHER PROPERTIES OF THE LINE SPECTRA. S. Sugano and I. Tsujikawa.
J. Phys. Soc. Japan, Vol. 13, No. 8, 899-910 (Aug., 1958).

The absorption intensities, widths and wave-numbers of R_1, R_2 and B_1 B_2 lines of Cr^{3+} in ruby for the polarized light $E \perp C_3$ and $E \parallel C_3$ were experimentally studied at 20° and 4.2°K. The Zeeman effect was also studied, using a magnetic field $H_0 = 24\,000\ \phi$, for both R and B lines. The Zeeman effect has not been observed yet for the B lines, while Lehmann has already observed the Zeeman effect for R lines. The present results for R lines improve on the quantitative aspects of Lehmann's experiment. Comparison is made with the theoretical results (preceding abstract), and it is shown that good agreement can be obtained when suitable assignments of the spectra are adopted and when fairly large g-shifts of the excited states are introduced.

539.2 : 535.34

647 SPECTRUM AND STRUCTURE OF TRIVALENT EUROPIUM IN EUROPIUM BROMATE. H.G.Kahle.
Z. Phys., Vol. 155, No. 2, 129-44 (1959). In German.

Absorption lines in the visible are photographed and the half-widths and integrated absorption intensities determined are tabulated for several temperatures in the range 68-290°K. It is concluded that the lattice symmetry of the Eu^{+++} ions is C_S with the monoclinic axis perpendicular to the pseudohexagonal crystal axis. From the term splitting, the real matrix elements of the crystal field are determined. G.F.Lothian

539.2 : 535.34

648 ZEEMAN EFFECT OF TRIVALENT EUROPIUM IN EUROPIUM BROMATE. H.G.Kahle.
Z. Phys., Vol. 155, No. 2, 145-56 (1959). In German.

The Zeeman pattern of the visible spectrum is photographed at 201°K for several combinations of directions of magnetic field, beam polarization and crystal axes. The observations agree with calculations from the interaction of applied and crystal fields. The phase of a complex matrix element of the crystal field may be determined from the observations. G.F.Lothian

539.2 : 535.34

649 ZEEMAN EFFECT OF TRIVALENT EUROPIUM IN EUROPIUM CHLORIDE, $EuCl_3.6H_2O$. H.G.Kahle.
Z. Phys., Vol. 155, No. 2, 157-69 (1959). In German.

The Zeeman splitting for the visible absorption lines for a single crystal is photographed at 77°K. From the observations, the position of the magnetic transition dipole moment is determined. The g-factors of the terms $^5D_1$ and $^5D_2$ are 1.43 and 1.44. The g values for several Eu salts have slightly different values, all lower than the Russell-Saunders value of 1.5, and this variation is discussed. G.F.Lothian

539.2 : 535.33

650 THE INFRA-RED SPECTRA OF SOME FERROELECTRIC COMPOUNDS WITH SHORT HYDROGEN BONDS. R.Blinc and D.Hadži.
Molecular Phys., Vol. 1, No. 4, 391-405 (Oct., 1958).

The infrared spectra of KH_2PO_4, $NH_4H_2PO_4$, NaH_2PO_4, KH_2AsO_4, $NH_4H_2AsO_4$, $Ag_2H_3IO_6$ and $(NH_4)_2H_3IO_6$ and of their deuterated analogues were recorded at room temperature and some of them also at low temperature in the ferroelectric phase. The interpretation of the particularly interesting spectral region between 3000 and 1500 cm^{-1}, containing several OH bands, was made in terms of the tunnelling of the protons between two minima of potential energy. These were taken to be of equal depth in the non-ferroelectric phase and unsymmetrical in the ferroelectric form. A quantum-mechanical treatment of the vibrational problem of the latter type has been carried out. Good agreement is found between the theoretically predicted energy levels and the experimental data.

539.2 : 535.34

651 INFRARED ABSORPTION IN SILICON OF HIGH SPECIFIC RESISTIVITY CONTAINING RADIATION DEFECTS. V.S.Vavilov, A.F.Plotnikov and G.V.Zakh atkin.
Fiz. tverdogo Tela, Vol. 1, No. 6, 976-9 (June, 1959). In Russian.

The absorption coefficient of p-type Si bombarded by 1 MeV neutrons to an integrated flux density of 5×10^{17} cm^{-2} was examined in the range 1-10 μ. Initially 65 ohm cm at room temperature, the resistivity rose to 2×10^5 ohm cm at 300°K corresponding to a hole concentration of 2.5×10^{11} cm^{-3}. A diagram of the optical arrangement is given together with the spectral response of the absorption coefficient both before and after bombardment. After bombardment an absorption peak appears at room temperature at 1.8 μ which increases in amplitude and shifts to 1.7 μ as the temperature is lowered to 20°K. Similar peaks are due to impurity atoms such as Au in Si and Au, Fe, Ni in Ge but assuming that each centre created removes one conduction electron the absorption section per centre at 10^{14} cm^{-3} is 200 times higher than the theoretical value. The oxygen concentration in the Si was less than 3×10^{16} cm^{-3}.

W.Bardsley

539.2 : 535.33 : 548.73

652 NITROGEN, A MAJOR IMPURITY IN COMMON TYPE I DIAMOND. W.Kaiser and W.L.Bond.
Phys. Rev., Vol. 115, No. 4, 857-63 (Aug. 15, 1959).

Common type I diamonds [as classified by Robertson et al. (Abstr. 2291 of 1934)], have additional absorption in the infrared and ultraviolet. It is shown that the strongest absorption band in the infrared at 7.8μ and the ultraviolet absorption at 3065 A are proportional to the nitrogen concentration of the crystal. A corresponding increase in lattice constant is found to be as high as 0.01% for a nitrogen content of 0.2%. Concentration, X-ray and density data suggest that nitrogen occupies a substitutional position in the diamond lattice. The infrared absorption bands at 7.8, 8.3, 9.1, and 20.8μ are considered to be C–N molecular vibrations. Several optical, electrical, and thermal properties of diamond are discussed in view of these findings.

539.2 : 535.33

653 EFFECTS OF MnO AND CoO ON THE 0.24 eV NiO ABSORPTION LINE. R.Newman and R.M.Chrenko.
Phys. Rev., Vol.115, No.4, 882-4 (Aug. 15, 1959).

The change was measured in the 0.24 eV NiO absorption band due to additions of MnO and CoO to NiO crystals. The results support the interpretation that the band has its origin in an antiferromagnetic effect.

539.2 : 535.345

654 ABSORPTION BY ZINC OXIDE IN THE INFRARED SPECTRAL REGION.
V.K.Miloslavskii and N.A.Kovalenko.
Optika i Spektrosk., Vol. 5, No. 5, 614-17 (1958). In Russian.

ZnO layers were produced by sputtering in an atmosphere containing oxygen. These layers exhibit high electrical conductivity and are transparent in the visible region. Their high conductivity is due to excess of Zn and it depends strongly on the rate of sputtering as well as on the atmosphere in which sputtering is carried out. Layers of high resistance (greater than 10^6 ohm) are transparent in the region from 1 to 16 μ. Layers with lower resistances exhibit continuous absorption from 3 to 16 μ with a sharp fall of absorption at the short-wavelength end. There is no simple relationship between the coefficient of absorption and resistivity of layers prepared under different conditions. On the other hand, if the sample resistance is altered by some treatment, then the absorption of this sample changes monotonically with the change in the resistance. The connection between absorption and conductivity indicates that absorption in the infrared region is due mainly to conduction electrons.

A.Tybulewicz

539.2 : 535.37

655 DIFFUSION OF ACTIVATORS IN LUMINESCENT ZINC SULPHIDE. H.Ortmann.
Semiconductors and phosphors (see Abstr. 9597 of 1959) p. 535-7. In German.

An account of the theory that pre-formed acceptor sites (sulphur vacancies), rather than coactivator atoms, are necessary for the activation of ZnS. (Abstr. 10283 of 1959). The fluorescence produced by subsequent diffusion of Cu activator into pre-fired material is green until all the acceptor sites are used by replacement of associated Zn atoms by Cu; when the Cu atoms are in excess of the number of sites, blue fluorescence appears. Phosphors containing CdS show similar behaviour. S.T.Henderson

539.2 : 535.37

656 SPATIAL DISTRIBUTION OF POLARIZATION OF LUMINESCENCE FROM STILBENE AND TOLANE CRYSTALS. V.N.Varfolomeeva and N.D.Zhevandrov.
Optika i Spektrosk., Vol. 5, No. 5, 571-81 (1958). In Russian.

Polarization of fluorescence of molecular crystals does not depend on anisotropy of excitation. The only spatial dependence of polarization in these crystals is the dependence on the angle between the direction of observation and some other fixed direction. The graphical representation of this dependence is called a polarization diagram. The authors obtained polarization diagrams for luminescence of spherical crystals of stilbene and tolane excited with 365 mμ. The degree of polarization was also measured for certain other molecular crystals. Analysis of all the polarization diagrams shows that both localized and free excitons take part in the process of luminescence. A.Tybulewicz

539.2 : 535.37

657 PRESSURE EFFECTS AND CONFIGURATION COORDINATE MODELS OF KCl(Tl). L.Reiffel.
Phys. Rev. Letters, Vol. 3, No. 5, 215-17 (Sept. 1, 1959).

As a test of the alternative configuration coordinate models proposed for KCl(Tl) crystals, the ratio of the intensities of the 4750 A and 3050 A emission bands was measured as a function of pressure at temperatures from 0°-19° C. Practically no change was observed in the intensity ratio up to 40 000 lb/in^2, which is not consistent with the Williams–Johnson "double minimum" model which requires a change by a factor of 2.7 under such conditions.

J.B.Birks

539.2 : 535.37

658 EDGE AND IMPURITY EMISSION IN CADMIUM SULFIDE. D.M.Warschauer and D.C.Reynolds.
Phys. Rev. Letters, Vol. 3, No. 8, 370-2 (Oct. 15, 1959).

The variation of the edge and impurity emission of a copper doped crystal was examined as a function of the angle of polarization. The edge emission reaches a peak for the electric vector perpendicular to the c-axis, whereas the impurity emission is a maximum for the electric vector along the c-axis. A band structure of CdS is proposed to account for these results. B.T.M.Willis

539.2 : 535.37 : 621.385.832

659 RISE AND DECAY OF INTENSITY OF LUMINESCENCE OF SHORT-PERSISTENCE PHOSPHORS. R.Feinberg.
Nature (London), Vol. 183, 1546-7 (May 30, 1959).

The luminescence rise-time τ_{r_1} and the luminescence decay-times τ_{d_1} and τ_{d_2} of the slow and fast components, and their relative magnitudes k_{d_1} and k_{d_2}, have been measured for ZnS:Ag, ZnS:Ag,Ni and ZnS : 36% CdS:Ag phosphors excited by 30 μsec pulses of 15 kV electrons. In general $k_{d_1} > k_{d_2}$, $\tau_{d_1} > \tau_{d_2}$, and $\tau_{r_1} > \tau_{d_1}$. Increase in the electron current density in each case decreases τ. The ultraviolet component (0.30 μ-0.43 μ) of the luminescence has lower values of τ than the visible component. It is proposed that the ratio τ_{d_1}/τ_{r_1} is a measure of the probability of non-radiative de-excitation. J.B.Birks

539.2 : 535.37

660 ELECTRONIC SPECTRA OF EXCHANGE-COUPLED ION PAIRS IN CRYSTALS.
A.L.Schawlow, D.L.Wood and A.M.Clogston.
Phys. Rev. Letters, Vol. 3, No. 6, 271-3 (Sept. 15, 1959).

Measurements were made of the satellite lines in the fluorescence emission of Cr^{3+} ions in Al_2O_3 and MgO. Some of the satellites are due to pairing of Cr ions or association of a Cr ion with a crystal defect. J.Franks

539.2 : 535.37 : 537.312

661 FORMAL ANALYSIS OF THE THEORY OF TWO-STEP EXCITATION OF PHOSPHORESCENCE AND PHOTOCONDUCTIVITY. II. RELAXATION RELATIONS.
N.A.Tolstoi and A.V.Shatilov.
Optika i Spektrosk., Vol. 5, No. 5, 590-600 (1958). In Russian.

In Pt I (Optika i Spektrosk., Vol. 1, 216, 1956) the authors considered steady-state relations which followed the two-step excitation theory. The present paper discusses relaxation relations which correspond to rise or decay of phosphorescence and photoconductivity under excitation by square pulses of light. It is assumed that decay processes begin after reaching a state of equilibrium under the pulse excitation, and the rise processes are taken to occur after complete relaxation of the excited states. A.Tybulewicz

539.2 : 535.37

662 PHOSPHORESCENCE SPECTRA AND DECAY TIMES OF AROMATIC HYDROCARBONS AND THEIR DONOR CCEPTOR COMPLEXES.

(Czekalla, G.Briegleb, W.Herre and H.J.Vahlensieck.
. Elektrochem., Vol. 63, No. 6, 715-21 (1959). In German.

The spectra and decay times of molecular compounds of etrachlorophthalichydrides with some hydrocarbons were obtained nd compared with the behaviour of the corresponding free hydrocarbons. With naphthalene, phenanthrene and benzanthracene, the pectra of the molecular compounds closely resembled those of the ree hydrocarbons. In solution, a slight red shift occurred, the ibrational structure was less marked but could still be analysed, ae decay time differed by not more than a factor 2 from that of the ree donor. The phosphorescence of the corresponding crystalline olecular compounds had shifted considerably further to the red, ae vibrational structure was coarse and decay times decreased by factor 10. In the durene complex, a strong red shift occurred in olution, the fine structure disappeared and the decay time dropped y a factor 20. In the solid complex, the decay time decreased by 0³. J.Franks

539.2 : 535.37

663 ON THE DAMAGE DONE TO PLASTIC SCINTILLATORS BY IONIZING RADIATIONS. II. I.M.Rozman.

zv. Akad. Nauk SSSR, Ser. fiz., Vol. 22, No. 1, 60-6 (1958).
n Russian. English summary: PB 141041T-1, obtainable from Office f Technical Services, U.S. Dept. of Commerce, Washington,D.C., .S.A.

For Pt I, see Abstr. 987 (1958). The luminescence efficiency of ure and activated polystyrene decreased with increasing radiation oses of α and β particles, and an increase in light absorption ccurred. There was some recovery after interruption of the β-adiation. The luminescence emission of pure polystyrene irradiated with α-particles follows the same law as that for organic monocrystals, the behaviour of activated polystyrene is more complex. nder β-particle excitation, polystyrene scintillators which had previously been irradiated, exhibited an afterglow. No such effect was ound with α-particles. J.Franks

539.2 : 535.37 : 539.1.07

664 FLUORESCENT RESPONSE OF CESIUM IODIDE CRYSTALS TO HEAVY IONS.

..R.Quinton, C.E.Anderson and W.J.Knox.
Phys. Rev., Vol. 115, No. 4, 886-7 (Aug. 15, 1959).

The light output from thallium-activated crystals was determined using C^{12}, N^{14}, and O^{16} as incident particles, with energies up o 10 MeV per nucleon. A photocathode with S-11 response viewed he scintillator light and the photomultiplier pulses were compared ith those produced by α-particles and protons of known energies. here is evidence that low-energy heavy ions are inefficient producers of light in this spectral region.

539.2 : 535.37

665 THERMOLUMINESCENCE OF THE RARE EARTHS IN CaF_2. H.Adler.

cta phys. Austriaca, Vol.12, No.4, 356-99 (1959). In German.

Earlier work on natural fluorite is briefly reviewed. Synthetic CaF_2 was fired at 850°C with Tb, Er, Sm, Dy, Eu and Mn, either ingly, or in pairs, or singly with Na. Activator contents were mostly .1% mol/mol. The luminescence under 60 kV X-rays was studied, articularly with regard to the different spectra emitted from amples fired in N_2 or air respectively, and also to the dependence f emission on temperature and activator content. Terbium shows arked differences attributed to Tb^{3+} and Tb^{4+}. Preparations treated or 40 min by 100 kV X-rays at 120 rad/sec were then heated at .5°/sec to provide glow curves, on which the paper gives considerble detail. Excepting Mn, all activators showed the largest glow eak at 80°C, whereas the exo-electron emission had a main peak at 0°C. A lengthy discussion of the mechanism follows. It appears hat the form of the glow curve is determined by the activator, but he properties of the traps arise from the matrix. Natural fluorites re multiply activated, but the colour changes in their emission dep- nd also on the different types of centre which each activator may rovide. S.T.Henderson

539.2 : 535.39

666 ON THE OPTICAL CONSTANTS OF COPPER AND GOLD. M.V.Savost'yanova.

ptika i Spektrosk., Vol. 5, No. 4, 469-72 (1958). In Russian.

In 1942 Givens published values of the optical constants of copper films produced in vacuum. Givens's curves do not exhibit a sharp peak in the region 500-600 mμ, which was earlier observed for copper and gold. Studies of the optical properties of colloidal solutions of metals give an independent method for verification of the wavelength dependences of the optical constants. This method was applied to copper and gold and the results obtained showed that the peak in the wavelength dependence of the refractive index and the absorption factor of copper and gold does in fact exist in the 500-600 mμ region and that Givens's results must be in error.
A.Tybulewicz

MAGNETIC PROPERTIES OF SOLIDS

539.2 : 538.2

667 ROTARY MAGNETIC POLARIZATION (FARADAY ROTATION) IN FERRIC AND CHROMIC PARAMAGNETIC SALTS AT 10 000 Mc/s. G.Raoult, R.Fanguin and A.Chabrier.
Arch. Sci. (Geneva), Vol. 12, Special No., 215-25 (1959). In French.

1959 Maxwell-Ampere Conference paper (see Abstr. 11542 of 1959). A high sensitivity apparatus to measure Faraday rotation in paramagnetic salts is described in detail. The apparatus has been tested by repeating measurements made by Gozzini (Abstr. 3748 of 1952) on manganese sulphate, nitrate, oxalate, chloride and sulphide. Identical results were obtained. Measurements have also been made on ferric sulphate, chloride, acetate, and nitrate, chromium sesquioxide and green chromium sulphate. S.A.Ahern

539.2 : 538.2

668 A CERTAIN ANOMALOUS BEHAVIOUR OF IRON SULFIDES. M.Murakami and E.Hirahara.
J.Phys. Soc. Japan, Vol. 13, No. 11, 1407 (Nov., 1958).

A magnetic susceptibility anomaly has been observed at about 110°C when iron sulphide is cooled from a temperature above this to lower temperatures; the anomaly does not appear as the temperature is raised. An explanation in terms of anisotropy and exchange energies is suggested. F.E.Hoare

539.2 : 538.2

669 MAGNETIC SUSCEPTIBILITY OF THORIUM METAL IN THE RANGE 130-300°K. J.F.Smith and J.D.Greiner.
Phys. Rev., Vol. 115, No.4, 884-5 (Aug.15, 1959).

Within the precision of measurement, the susceptibility was found to remain constant at a value of $+0.410 \pm 0.002$ emu/g. This susceptibility behaviour is in contrast to the elastic behaviour (Armstrong et al., Abstr. 6321 of 1959) which indicates a change in the character of the interaction forces near 253°K.

539.2 : 538.2

670 AN ORDER–DISORDER TRANSFORMATION PHENOMENON IN THE $FeTiO_3$–Fe_2O_3 SOLID SOLUTION SERIES. Y.Ishikawa.
J. Phys. Soc. Japan, Vol. 13, No. 8, 828-37 (Aug., 1958).

The effects of heat treatment on the magnetic properties of the synthesized solid solution $xFeTiO_3-(1-x)Fe_2O_3$ of ilmenite and hematite were examined in detail for compositions $x \sim 0.5$. It was confirmed that a transformation from an ordered state (ferrimagnetic) into a disordered state (antiferromagnetic) takes place cooperatively at a distinct transition point. This transformation temperature is lowered with decrease in the ilmenite content from 1100° C for $x = 0.65$, to 600° C for $x = 0.45$. The completely disordered specimens could not be obtained for the composition $x \geq 0.6$ by the quench method, while the completely ordered state could not be attained in the specimens with $x \leq 0.5$ because of decrease of the transformation temperature for these specimens and a reduction of the rate of ion diffusion at such low temperatures. The results obtained are discussed using the Bragg–Williams approximation. It is noted that the reverse thermo-remanent magnetism found in this system is closely related to the order–disorder transformation phenomenon which exists in this system.

539.2 : 538.2

671 FERRIMAGNETISM OF MIXED CRYSTALS OF Mn_4N WITH CHROMIUM, IRON AND NICKEL.
R.Juza, K.Deneke and H.Puff.
Z. Elektrochem., Vol. 63, No. 5, 551-7 (1959). In German.

Reports results of the lattice constant, Curie point and magnetic moment of $Mn_{4-x}M_xN$, where M = Cr, Fe, Ni; the results are interpreted in terms of ferrimagnetic coupling effects
E.P.Wohlfarth

539.2 : 538.2

672 INVESTIGATION OF THE FINE STRUCTURE OF THE X-RAY ABSORPTION SPECTRUM OF IRON IN VARIOUS ANTIFERROMAGNETICS AND FERRITES.
E.Ee.Vainshtein, B.I.Kotlyar and G.A.Shapiro.
Dokl. Akad. Nauk SSSR, Vol. 125, No. 1, 55-8 (March, 1959). In Russian.

A quartz crystal spectrometer of dispersion 3.8 mm/X.U. was used to determine the Fe K-edge of thin films of Fe_2O_3, $NiO.Fe_2O_3$, etc. The results are plotted graphically, and correlated with electron states. T.Mulvey

539.2 : 538.2

673 MEASUREMENT OF TEMPERATURE DEPENDENCE OF THE FERROMAGNETIC HALL EFFECT ON EVAPORATED FILMS OF NICKEL FOR THE DETERMINATION OF THE CURIE TEMPERATURE. L.Reimer.
Z. Phys., Vol. 155, No. 5, 524-30 (1959). In German.

The Curie temperature of thin films of nickel was determined by the Hall potential in a constant field of 6 kOe in a temperature range of 20° to 400°C. Films deposited around 200°-300°C exhibit a Hall effect which is largely reversible with temperature. For films deposited at room temperature the Hall effect and the resistance change irreversibly with the temperature of measurement. The results show that the Curie temperature of a film of given thickness is lower when deposited at room temperature than at an elevated temperature. This is explained in terms of the small size of crystallites in films deposited at room temperature. R.Parker

539.2 : 538.2 : 530.16

674 STATISTICAL MECHANICAL THEORY OF A RANDOM FERROMAGNETIC SYSTEM. R.Brout.
Phys. Rev., Vol. 115, No. 4, 824-35 (Aug. 15, 1959).

The behaviour of solid solutions of paramagnetic impurities which are exchange-coupled in a nonmagnetic substrate turns out to yield a considerable body of information with regard to the nature of the exchange coupling as well as detailed temperature dependence of the spin system. A rigorous expansion of the mean free energy averaged over random sites is presented. It is shown that a ferromagnetic phase transition does occur. The Curie point is given as a function of concentration for the case of weak dilution in an implicit power series form. Many interesting qualitative features arise in the study of these systems. If the curve of magnetic moment versus temperature has inflections this indicates short-range exchange forces, whereas smooth curves indicate long-range forces. Similarly, long-range forces give rise to smooth behaviour of the Curie point as a function of concentration for dilute samples. Alternatively, short-range forces give rather violent changes in Curie point near atomic fractions $\approx$ (number of nearest neighbours)$^{-1}$. The method of series development used gives rise to this expected qualitative behaviour and also permits quantitative prediction to be made if the exchange potential is known. Consideration is also given to the antiferromagnetic analogue together with a discussion of expected behaviour of such systems in a resonance experiment.

539.2 : 538.2

675 THE VARIATION OF THE MAGNETIZATION OF A SINGLE CRYSTAL OF $PbO.6Fe_2O_3$ AS FUNCTION OF FIELD. R.Pauthenet and G.Rimet.
C.R. Acad. Sci. (Paris), Vol. 249, No. 5, 656-8 (Aug. 3, 1959). In French.

The magnetization of a single crystal sphere was measured at various angles to the hexagonal axis and in fields up to 3×10^4 oersted. The results were interpreted in terms of rotational and translational magnetization processes. The following results were deduced from the measurements: $K_1 = 2.2 \times 10^6$ erg cm^{-3}; $K_2 = 3.1 \times 10^4$ erg cm^{-3}; $I_0 = 320$ gauss, i.e. $2K_1/I_0 = 1.38 \times 10^4$ oersted. E.P.Wohlfarth

539.2 : 538.2

676 THE MEASUREMENT OF THE PROBABILITY DISTRIBUTION OF BARKHAUSEN JUMPS IN A FERROMAGNETIC MATERIAL. H.Wilde and H.Girke.
Z. angew. Phys., Vol. 11, No. 9, 339-42 (Sept., 1959). In German.

If a ferromagnetic is cyclically magnetized between positive and negative saturation any point on the resulting hysteresis loop may be used as the starting point for an infinite number of secondary loops with varying amplitudes. It is shewn that the probability density of Barkhausen jumps in the Preisach diagram may be derived from the set of secondary loops. The reversible contributions to the magnetization are neglected. The method is demonstrated with two ferrite specimens, one with a conventional loop for a high permeability material, the other with Perminvar characteristics. The probability density is displayed in graphical form. R.Parker

539.2 : 538.2

677 THE MAGNETIZATION OF COBALT–ALUMINIUM, COBALT–SILICON, IRON–ALUMINIUM AND IRON–SILICON ALLOYS.
D.Parsons, W.Sucksmith and J.E.Thompson.
Phil. Mag. (Eighth Ser.), Vol. 3, 1174-84 (Oct., 1958).

The rate of change of magnetic moment with composition in several ferromagnetic cobalt-rich and iron-rich alloys of these systems was derived from measurements of the variation of spontaneous magnetization with temperature. The measurements were made on the high-temperature face-centred cubic phase of the cobalt alloys, the magnetic moments at absolute zero being obtained by a suitable extrapolation procedure. In the Fe–Al and Fe–Si alloys, the initial rate of change of moment with composition corresponds to a simple dilution of the iron by the solute element, and increases in the range of compositions where ordering is known to exist. In the Co–Al and Co–Si alloys, the rate of change of moment with composition does not correspond to the number of valence electrons normally associated with the solute elements.

539.2 : 538.2

678 A CONSEQUENCE OF THE SIMILARITIES IN THE MAGNETIZATION OF MIXED FERRITES. L.N.Sȳrkin.
Fiz. tverdogo Tela, Vol. 1, No. 10, 1538-9 (Oct., 1959). In Russian.

The author takes Popper's result that the curve of λ/λ_S as a function of I/I_S (where λ = linear magnetostriction, I = intensity of magnetization, and the subscript s refers to saturation) is the same regardless of the percentage of Zn in Ni–Zn ferrites, and writes for the group of ferrites $Ni_{1-x}Zn_xFe_2O_4$:

$$\frac{\lambda(I,x)}{\lambda_S(x)} = f\left(\frac{I}{I_S}\right) = f(y).$$

This leads to

$$\lambda/\lambda_S = \partial\lambda/\partial x : \partial\lambda_S/\partial x.$$

In other words, if tangents are drawn to the $\lambda(x)$ curves at points corresponding to the same value of x (i.e. ferrites of the same composition with different intensities of magnetization), they all intersect at the same point on the x-axis. The experimental value of this result is pointed out. D.E.Brown

539.2 : 538.2

679 CONTRIBUTION TO THE STUDY OF THE MAGNETIZATION OF FINE WIRES UNDER TENSILE STRESS, IN WEAK ALTERNATING FIELDS. C.Moncuit.
Ann. Phys. (Paris), Ser. 13, Vol. 4, No. 5-6, 489-544 (May-June, 1959). In French.

An extensive comparative study of nickel, iron and steel wires 100 μ diameter in the work hardened and annealed states, when subjected to tensile stresses. The measurements include: (1) losses at frequencies up to 2 Mc/s; (2) permeability up to 200 kc/s in weak fields (Rayleigh region); (3) electrical resistance measurements. 63 references. A.J.Manuel

Magnetic Resonances

539.2 : 538.27

680 A RESONANCE PHENOMENON IN A MAGNETICALLY ANNEALED PERMINVAR FERRITE. H.Rabl.
Z. angew. Phys., Vol. 11, No. 2, 57-63 (Feb., 1959). In German.

The power factor of ring shaped specimens of $Co_{0.02}$ $Mn_{0.06}$ $Ni_{0.72}$ $Fe_{2.2}$ O_4 ferrite, slowly cooled from above the Curie point in a magnetic field of 1000 Oe perpendicular to the plane of the ring, showed many resonant peaks in the frequency range 1-14 Mc/s. By localizing the measuring field individual resonances were associated with definite regions of the specimens. The resonances are attributed to magnetostrictive oscillations. A.J.Manuel

539.2 : 538.27

681 ELECTRON PARAMAGNETIC RESONANCE SPECTRUM OF POTASSIUM CHROMICYANIDE MAGNETICALLY DILUTED IN A SINGLE CRYSTAL OF POTASSIUM COBALTICYANIDE. G.Berthet, F.Blanc, J.Grangeon and G.Raoult.

Arch. Sci. (Geneva), Vol. 12, Special No., 226-33 (1959). In French.

1959 Maxwell-Ampere Conference paper (see Abstr. 11542 of 1959). The paramagnetic resonance spectrum of potassium chromicyanide in a mixed crystal of $K_3Co(CN)_6$:Cr containing 0.5% of the chromium salt has been studied at room temperature using a conventional X-band spectrometer. The observed results are in good agreement with the spin-Hamiltonian proposed by Baker et al. (Abstr. 2490 of 1957). S.A.Ahern

539.2 : 538.27

682 PARAMAGNETIC RESONANCE DETECTION OF THE OPTICAL EXCITATION OF AN INFRARED STIMULABLE PHOSPHOR. R.S.Title.

Phys. Rev. Letters, Vol. 3, No. 6, 273-4 (Sept. 15, 1959).

E.S.R. of the Eu^{2+} ion was observed in SrS:Eu,Sm stimulable phosphor with the composition: SrS, 6% $SrSO_4$, 6% CaF_2, 0.02% Eu, 0.02% Sm. The results confirmed Keller's simplified band theory model (Abstr. 6765 of 1959) in which the net effect of the excitation is to produce the reaction

$$Eu^{2+} + Sm^{3+} \xrightarrow{h\nu} Eu^{3+} + Sm^{2+}.$$

As Eu^{3+} is nonmagnetic the intensity of the e.s.r. spectrum decreases when the excitation occurs. The relative stored energy (proportional to the decrease in e.s.r. signal) was measured at room temperature as a function of the wavelength of the exciting light: this agreed with the determination by Keller, Mapes and Cheroff (Abstr. 2985 of 1958), who used the stimulated phosphorescence to estimate the stored energy. J.M.Baker

539.2 : 538.27

683 PARAMAGNETIC RESONANCE SPECTRUM OF MANGANESE IN SINGLE CRYSTALS OF ALKALI HALIDE GROWN FROM THE MELT.

T.Fukudu, Y.Uchida and H.Yoshimura.

J. Phys. Soc. Japan, Vol. 13, No. 8, 971-2 (Aug., 1958).

Paramagnetic resonance spectra of Mn^{++} in single crystals of LiCl and KCl, grown from the melt, and containing 1 mol. % Mn, were studied at 290°K using a 1 cm field-modulation spectrometer. The observed spectra are described for varying conditions of heat treatment. For KCl:Mn the measured g-value is 2.005 ± 0.002 observed after quenching the crystal from 500°C); for LiCl:Mn the value is 2.003 ± 0.001. S.A.Ahern

539.2 : 538.27

684 NONRESONANT NUCLEAR SPIN ABSORPTION IN LITHIUM, SODIUM, AND ALUMINUM. A.G.Anderson.

Phys. Rev., Vol. 115, No. 4, 863-8 (Aug.,15, 1959).

Audio-frequency spin absorption was observed in the nuclear spin systems of the metals Li, Na and Al. In Li and Na, the observed second moment of the absorption line at zero d.c. magnetic field is in agreement with calculations assuming only magnetic dipole–dipole interactions; in Al the zero-field absorption extends to frequencies as high as 50 kc/s and the second moment of the absorption line appears to be about 50% larger than expected. Spin absorption was also observed at small applied d.c. magnetic fields, H_0, for audio-frequency magnetic excitation both parallel to and perpendicular to H_0. In both of these cases, absorption occurs at γH_0 and $2\gamma H_0$, in agreement with theory.

539.2 : 538.27

685 NUCLEAR QUADRUPOLE SPECTRA OF BORON TRICHLORIDE AND TRIBROMIDE. T.Chiba.

J. Phys. Soc. Japan, Vol. 13, No. 8, 860-8 (Aug., 1958).

The pure quadrupole resonance spectra were observed on Cl^{35} and Cl^{37} in BCl_3, and on Br^{79} and Br^{81} in BBr_3 at several temperatures. The spectrum of each nucleus consists of a characteristic doublet (ν_I and ν_{II}) with the intensity ratio of about 3 to 5. The Zeeman study with a single crystal of BBr_3 was also carried out at 77°K, to determine the asymmetry parameter η. The ionic character and the double bond character are estimated to be i = 0.42 and f = 0.11, respectively, for the B–Br bond. In BCl_3, f = 0.06 is obtained by assuming i = 0.50. The double bond characters of these compounds are rather smaller than usually assumed. The doublet separation cannot be explained by direct nuclear dipole–dipole interaction. A reasonable explanation is offered by taking into account the effect of the intramolecular vibration: B^{10} and B^{11} provide different mean square amplitudes to the bending vibrations of BX_3, which in turn produce a difference of q for $B^{10}X_3$ and $B^{11}X_3$ molecules. The effect is calculated by use of the normal frequencies of BCl_3 and BBr_3. A fair agreement was obtained between the observed separation of the doublet and the calculated one. The observed intensity is also compatible with this assumption.

539.2 : 538.27 : 548.73

686 ZEEMAN STUDY ON NUCLEAR QUADRUPOLE RESONANCES IN AsI_3 AND $AsI_3.3S_8$. Y.Abe.

J. Phys. Soc. Japan, Vol. 13, No. 8, 918-27 (Aug., 1958).

Principal axis systems and asymmetry parameter of the electric field gradient tensors were determined by studying Zeeman effect of nuclear quadrupole resonances of As^{75} and I^{127}. The iodine resonance in AsI_3 showed that there are three principal axis systems whose z-axes form a trigonal pyramid having an apex angle of 91.7° ± 2.5°. The fact that this angle did not agree with the bond angle of 88° 2' supports the mechanism of resonance switching of the bond. The arsenic resonance in AsI_3 has only one principal axis system whose z-axis is along the trigonal symmetry axis of arsenic tri-iodide molecule. The asymmetry parameter obtained from Zeeman study was nearly zero. The iodine resonance in $AsI_3.3S_8$ also showed that there are three principal axis systems. This fact well agrees with the result from X-rays that the most possible crystal structure of $AsI_3.3S_8$ is C_{3V}^1. Three z-axes are parallel to the edge of a trigonal pyramid with an apex angle of 101.7° ± 0.5° which is close to the bond angle 100° ± 2° (∠I–As–I) of AsI_3 molecule in gaseous state. The electric field gradient tensor of arsenic resonance in $AsI_3.3S_8$ was nearly axial symmetric about the trigonal symmetry axis of the molecule.

539.2 : 538.27

687 PURE NUCLEAR QUADRUPOLE RESONANCES IN PARAMAGNETIC IRON-GROUP HALIDES.

R.G.Barnes and S.L.Segel.

Phys. Rev. Letters, Vol. 3, No. 10, 462-4 (Nov. 15, 1959).

The quadrupole resonances of chlorine in polycrystalline $TiCl_2$, $TiCl_3$, VCl_3, $CrCl_2$ and $CrCl_3$, and of bromine in $CrBr_3$, have been observed at temperatures above the magnetic ordering temperatures, where known, of the salts. The narrowness of the lines is attributed to the reduction of the effects of the dipolar fields of the magnetic ions by their exchange interactions. E.F.W.Seymour

MECHANICAL PROPERTIES OF SOLIDS

539.211

688 THE MECHANISM OF FORMATION OF EMBRYONIC CRACKS DURING PLASTIC DEFORMATION OF CRYSTALS. V.N.Rozhanskii.

Dokl. Akad. Nauk SSSR, Vol. 123, No. 4, 648-51 (1958). In Russian.

In addition to the mechanisms proposed by Mott and Stroh (Abstr. 10021 of 1955, 3319 of 1956) and Fujita (Abstr. 5688 of 1957), it is suggested that cracks may arise in the region of the nucleus of an edge dislocation by bending of the atomic planes parallel to the slip plane. The effects is shown clearly with amalgamated zinc crystals, photographs of which are reproduced. The theoretical size of the cracks produced in this way is compared with the size estimates from electrical resistance measurements (Abstr. 3082 of 1958). R.F.S.Hearmon

539.211

689 BRITTLE RUPTURE OF ZINC SINGLE CRYSTALS. E.D.Shchukin and V.I.Likhtman.

Dokl. Akad. Nauk SSSR, Vol. 124, No. 2, 307-10 (1959). In Russian.

By considering the stress concentration around Griffiths cracks, it is found that the critical normal and shear stresses (p_c and τ_c, respectively) are given by $p_c = \kappa\sqrt{\tan\chi}$ and $\tau_c = \kappa\sqrt{\cot\chi}$, where χ is the angle between the slip plane and the direction of the tensile stress, and κ is a constant. These expressions show good agreement with previous experiments on zinc single crystals (Abstr. 7572 of 1958). See also Abstr. 4484 (1958) and preceding abstract.

R.F.S.Hearmon

539.211

690 THE DUCTILE–BRITTLE TRANSITION IN THE FRACTURE OF α-IRON. I. N.J.Petch.

Phil. Mag. (Eighth Ser.), Vol. 3, 1089-97 (Oct., 1958).

A criterion for the transition in fracture mode from ductile to cleavage is calculated for fracture at a notch. It is concluded that the temperature-dependence of this transition probably arises more from that of the Peierls–Nabarro stress required to move a free dislocation in a α-iron than from the temperature-dependence of the locking of a dislocation source. The transition temperature is found to be a function of grain size, the friction on a free dislocation, the strength of the dislocation locking, the degree of triaxiality of the applied stress and the elastic constants.

539.211

691 THE DUCTILE–BRITTLE TRANSITION IN THE FRACTURE OF α-IRON. II. J.Heslop and N.J.Petch.
Phil. Mag. (Eighth Ser.), Vol. 3, 1128-36 (Oct., 1958).

The expressions obtained in a previous paper (preceding abstr.) for the fracture–mode transition temperature at a notch are shown to agree well with experimental measurements of its variation with grain size and with the friction on a free dislocation. A calculation is given of the effect of the dislocation locking strength on the transition temperature and this is in reasonable agreement with the observed temperatures for steels with weakened locking due to the presence of manganese. It is suggested that strain and strain-ageing raise the transition temperature because of the increased tensile stress available at fracture for the propagation of a dislocation crack.

539.211

692 NUCLEATION OF CRACKS BY THE INTERSECTION OF TWINS IN α-IRON. D.Hull.
Phil. Mag. (Eighth. Ser.), Vol.3, 1468-9 (Dec., 1958).

An experimental study of the initiation of fracture by twinning in a 3% silicon iron. Higher test temperatures may produce cracks at the intersection of slip planes. P.G.Morgan

539.31

693 NEWTONIAN THEORY OF AXIAL ELASTICITY. I-II. A.N.Procter.
Engineering (London), Vol. 187, 798-800 (June 19); Vol. 188, 3-4 (Aug. 7, 1959).

Newton stated that a hard elastic body bends or yields inwards under pressure without sliding of its parts and then returns to its initial shape under the force due to mutual attraction of these parts. A number of problems relating to the action of simple compressive or tensile forces on solid elastic materials are reconsidered in the light of this and other statements by Newton. Under simple compressive forces, elastic materials fail in ways incompatible with the assumption of a uniform distribution of stress. Shear failure occurs in specimens subjected to direct compression and size of test-piece affects the crushing strength. Simple strain energy considerations, based on Newton's work, show that, with cylindrical specimens, a short length causes a large part of the applied force to be absorbed in direct compression and only a small part in shear, while, for long specimens, the applied force is mainly absorbed in shear. Tests on metals show an increase of Young's modulus with rise of applied stress up to a maximum value, beyond which the modulus decreases slightly and remains constant. In tension, the point of failure is probably localised by small secondary bending stresses. Under impact conditions, it is shown that purely elastic materials should give coefficients of restitution from 0.7 to 1, lower values occurring when the stress at impact exceeds the elastic limit.
A.C.Whiffin

539.31

694 NEWTONIAN THEORY OF AXIAL ELASTICITY. III. A.N.Procter.
Engineering (London), Vol. 188, 37-8 (Aug. 14, 1959).

It is claimed that photoelastic analysis started when Brewster, a Newtonian scholar, discovered birefringence, and that such methods can be employed to locate the secondary shear strains inside transparent specimens. Starting from Newton's equation that the velocity of sound through a medium is proportional to the square root of (elasticity/density), a description is given of the usage of the measurement of the velocity of ultrasound through test pieces to determine the stress at which a change of velocity occurs, believed to be associated with the formation of microcracks. A.C.Whiffin

539.31

695 INTERNAL FRICTION IN IRON AT LOW TEMPERATURES. L.J.Bruner.
Phys. Rev. Letters, Vol. 3, No. 9, 411-2 (Nov. 1, 1959).

Reports measurements on vacuum melted and zone refined iron from 350°K down to 4.2°K. The internal friction rises steadily with decreasing temperature, then becomes constant below 50°K; no peaks are observed. A mechanism based on the motion of paired partial dislocations is suggested to account for the results. H.Mykura

539.32

696 THE ELASTIC CONSTANTS OF ALKALI HALIDE CRYSTALS AT ABSOLUTE ZERO. A REVIEW AND DISCUSSION. J.Lothe.
Arch. Math. Naturvid., Vol. 55, No. 4, 20 pp. (1959).

Estimates are made of the contributions to deviations from the Cauchy relations caused by zero point lattice vibrations, charge displacements due to overlap, and Coulomb-field induced quadrupole moments. Theoretical and experimental values for the elastic stiffnesses of LiCl, NaCl and KCl are compared. R.F.S.Hearmon

539.37

697 THE STRAIN-DEPENDENCE OF RUBBER VISCOELASTICITY. I. THE REGION OF MODERATE STRAIN. P.Mason.
Trans Faraday Soc., Vol. 55, Pt 8, 1461-9 (Aug., 1959).

A method is described by which the strain dependence of each component of the dynamic Young's modulus may be represented at a given temperature and frequency by two parameters. Values of the modulus components for natural, butadiene-acrylonitrile and butyl rubbers were derived from observations of the velocity and attenuation of 1 kc/s longitudinal waves in filaments stretched by amounts up to 100%. At each extension, measurements were made over a range of temperatures and it was found possible to represent the viscoelastic behaviour of each polymer by the above parameters. To enable comparisons between the polymers to be made in relation to the appropriate glass-transition temperatures a subsidiary examination was made of the strain-dependence of the glass-transition temperature of each polymer. Changes between +3° and –4°C were observed for strains up to 300%, and it is shown that these changes must result primarily from structural changes in the polymer other than simple dilatation.

539.37

698 RELAXATION EQUATIONS FOR THE CALCULATION OF VISCOELASTIC DEFORMATION. V.A.Solov'ev.
Zh. tekh. Fiz., Vol. 29, No. 3, 350-3 (1959). In Russian.

The author develops the stress–strain relation for viscous (plastic) substances in terms of the distribution functions, following Gross (Abstr. 1657 of 1947) and Gross and Pelzer (Abstr. 8273 of 1951). Their treatment is extended by also taking into consideration the instantaneous pliability, and thus arrives at modified transformation pair of distribution functions of retardation and relaxation times of stress. J.K.Skwirzynski

539.37 : 550.34

699 THE DISPLACEMENT FIELD DURING TOTAL RUPTURE IN AN ELASTIC MEDIUM. A.V.Vvedenskaya.
Izv. Akad. Nauk SSSR, Ser. geofiz., (1959) No.4, 516-26. In Russian.

The author determines the dynamical field of displacement in an isotropic, homogeneous and elastic medium during instantaneous breakage and considers the resulting motion of the limits of this rupture. The method of solution is based on and uses the results of the dislocation theory of Volterra; in particular the distribution of stress on the limits of the rupture during its development is determined. The results so obtained can be applied to determine the stresses and ruptures accompanying earthquakes.
J.K.Skwirzynski

539.38

700 STABILITY OF AN ANISOTROPIC CYLINDRICAL SHELL UNDER TORSION, WITH AN INTERNAL PRESSURE. V.M.Darevskii and S.N.Kukudzhanov.
Dokl. Akad. Nauk SSSR, Vol. 123, No. 1, 49-52 (1958). In Russian.

The paper presents a generalization of similar results on isotropic shells, presented previously by Darevskii (Izv. Akad. Nauk SSSR, Otdel tekh. Nauk., No. 11, 1957). The torsional moments are applied to the cylindrical shell, of "medium" length, on the circular edges of both closed ends, which are assumed to be rigid. The critical moment is obtained in terms of anisotropic elastic constants, thickness and radius of the shell, as well as the internal pressure.
J.K.Skwirzynski

539.4

701 THE ORIENTATION DEPENDENCE OF CYCLIC WORK-HARDENING IN ALUMINIUM CRYSTALS. P.Charsley and N.Thompson.
Phil. Mag. (Eighth Ser.), Vol. 3, 1098-104 (Oct., 1958).

Crystals of aluminium were subjected to several hundred slow cycles of stress: the rate of decrease of the width of the hysteresis loop is taken as a measure of cyclic work hardening. The manner of hardening depends on the orientation of the crystal and is qualitatively similar to the hardening observed in unidirectional straining.

539.43

702 THE EFFECT OF ATMOSPHERIC CORROSION ON METAL FATIGUE. N.J.Wadsworth and J.Hutchings.
Phil. Mag. (Eighth Ser.),Vol. 3, 1154-66 (Oct., 1958).

Polycrystalline specimens of copper, aluminium and gold were fatigued in reversed bend in various pressures of air and in water vapour and inert gases. The ratio of life in atmosphere of air to that in vacuum ($\sim 10^{-5}$ mm Hg) at lives of about 10^6 cycles was 1 : 20 for copper, 1 : 5 for aluminium and about 1 : 1 for gold. Some specimens were examined at intervals during the test. Small cracks a few microns deep formed in the first few hundredths of the life in air and after the same number of cycles in vacuum. The effect of air was to speed the propagation of cracks in copper and aluminium but not gold. Electron micrographs showed that extrusions and intrusions can occur close to each other in the same slip band.

539.53

703 MAKING SPHERES OF CRYSTALS WITH ANISOTROPY OF HARDNESS. J.Durand.
Rev. sci. Instrum., Vol.30, No. 9, 840-1 (Sept., 1959).

Bond's method (Abstr. 7843 of 1954) was used but the cutting continued till the tubes came into contact. J.E.Caffyn

539.57

704 SURFACE RE-ORIENTATION CAUSED ON METALS BY ABRASION — ITS NATURE, ORIGIN AND RELATION TO FRICTION AND WEAR. V.D.Scott and H.Wilman.
Proc. Roy. Soc. A, Vol. 247, 353-68 (Sept. 30, 1958).

Electron-diffraction investigation of undirectionally abraded beryllium and magnesium elucidates the characteristic nature and the origin of the fibre texture causes by abrasion, particularly its relation to the friction coefficient and the wear. The effects of a wide variety of conditions of load, speed, temperature and abrasive-particle size were determined. The main fibre orientation developed is of [001] type, the axis being included by an angle δ away from the outward normal, towards the direction from which the abrasive particles came. For beryllium δ is about 21°, the fibre axis being then along the resultant of the normal load W and the tangential frictional force F, at $\tan^{-1}\mu = \tan^{-1} 0.38$ to the normal. For magnesium $\delta = 22°$ and $\mu = 0.40$. This main oblique fibre orientation is clearly a compression texture, the (0001) slip lamellae becoming oriented normal to the compression axis. A very weak tendency of azimuthal preference round the axis, with <100> normal to the abrasion direction, was also observed in a few cases. With increasing load (above 1 Kg/cm², using 0000 emery paper) on beryllium, in addition to the above main oblique texture the surface regions showed an increasing proportion of metal having a [001] fibre orientation with its axis normal to the surface, associated with the progressively greater amount of metal removed by shearing. Similar oblique and normal [001] fibre textures are developed by abrasion on single-crystal beryllium surfaces, showing clearly the extent of the lattice fragmentation. The region of transition to the underlying undisturbed crystal lattice indicated by its form that the deformation process involves flexural rotational slip on (0001), i.e. rotational slip on (0001) with simultaneous flexure of the slip lamellae about an axis parallel to (0001) not limited to the usual <210> direction.

CRYSTALLOGRAPHY
CRYSTAL STRUCTURES

539.2 : 548 : 621.382

705 CRYSTALLOGRAPHIC ORIENTATION OF SEMICONDUCTORS. S.Marshall.
B.T.-H. Activ., Vol. 30, No. 4, 170-4 (July-Aug., 1959).

Describes a simple optical technique, claimed to be accurate to about 2 minutes of arc, which depends upon the reflection of a parallel beam of white light by the low-index crystallographic planes produced by suitably etching a lapped surface, the reflected beam being arranged to retrace the path of the incident beam through a lens to a pinhole in an observation screen. F.F.Roberts

539.2 : 548.5

706 ZONE MELTING OF SILICON BY ELECTRON BOMBARDMENT. V.Gusa, I.Krzhizh and I.Ladnar.
Fiz. tverdogo Tela, Vol. 1, No. 2, 290-3 (Feb., 1959). In Russian.

Difficulties normally associated with the application of electron bombardment for zone melting of Si were successfully overcome by using a cathode with a device for focusing the electron beam, and by making arrangements for rotating the Si rod during melting. M.H.Sloboda

539.2 : 548.5

707 ZONE-REFINED BORON. F.H.Horn.
J. appl. Phys., Vol. 30, No. 10, 1612-13 (Oct., 1959).

Boron was zone-refined in boats made from hot-pressed BN. Spectroscopic analysis showed that Si, Cu and Ti are difficult to remove, and optical absorption measurements suggested that B is intrinsic above about 1.8 eV. The crystal structure was found to be the same rhombohedral structure as that reported by Sands and Hoard [J. Amer. Chem. Soc., Vol. 79, No. 20, 5582 (Oct. 20, 1957)]. J.Thewlis

539.2 : 548.5

708 EXPERIMENTAL WORK ON GROWING SINGLE CRYSTALS OF FERROELECTRIC SUBSTANCES. N.S.Novosil'tsev, A.L.Khodakov, M.L.Sholokhovich, E.G.Fesenko and O.P.Kramarov.
Kristallografiya, Vol. 4, No. 1, 101-8 (1959). In Russian.

A review, with 48 references, of the authors' work on the dielectric properties, structure and morphology of $BaTiO_3$-type ferroelectric materials as related to their physico-chemical properties and crystallization conditions. Curves are given for dependence of dielectric constant on temperature for solid solutions of $(Pb,Sr)TiO_3$ with different Pb contents, and for dependence of Curie temperature on Pb content. See also following abstract. R.F.S.Hearmon

539.2 : 548.5

709 PRODUCTION OF FERROELECTRIC SINGLE CRYSTALS BY THE ZONE RECRYSTALLIZATION METHOD. O.P.Kramerov.
Kristallografiya, Vol. 4, No. 1, 109-13 (1959). In Russian.

A special furnace is described for converting polycrystalline material of the perovskite type into single crystals by heat treatment. The characteristics of the single crystals are discussed, and a curve is given for dependence of dielectric constant on temperature for one of the $(Ba,Pb)TiO_3$ solid solutions produced by the method. R.F.S.Hearmon

539.2 : 548.5

710 GROWTH OF SINGLE CRYSTALS OF BaO. R.T.Lynch and J.J.Lander.
J.appl. Phys., Vol. 30, No.10, 1614-15 (Oct., 1959).

$Ba(OH)_2$ was heated in dry H_2 (flow rate 50 cm³/min) at 500-550°C. A temperature gradient of 20-25°C caused growth of a cake of cubic crystals as the decomposition preceded by removal of water vapour. The solubility of BaO in $Ba(OH)_2$ was measured over the temperature range 600-1000°C. J.E.Caffyn

539.2 : 548.5

711 THE GROWTH OF NaCl CRYSTALS FROM THE SUBLIMED VAPOUR. Chang Yuan-lung.
Scientia Sinica, Vol. 8, No. 6, 629-41 (1959).

The vapour was sublimed from single crystals of NaCl grown from the melt, and microscopic observations were carried out on the sublimed crystals. Nucleation from corners was more frequent than in solution-grown crystals and the {122} form was developed, although this is a rare form in growth from solution. Various surface features are described, including concave and convex growth pyramids, interpenetrating growths and oriented overgrowths. B.T.M.Willis

539.2 : 548.5

712 AN UNCOMMON GROWTH FEATURE IN DIAMOND. A.Halperin.
Phil. Mag. (Eighth Ser.), Vol. 3, 1057-60 (Oct., 1958).

Uncommon growth features which extend as terraces from the edges of growth sheets on octahedral faces of a diamond are described. One of these features is extraordinarily flat, probably down to atomic dimensions over its whole area ($\frac{1}{3} \times \frac{1}{2}$ mm). From the characteristics of this feature it is concluded that in the last stage of growth of the diamond, when trigons are formed on its surface, growth sheets become frozen and growth proceeds only to the fixed edges.

539.2 : 548.5

713 EXPERIMENTS ON THE INDICATION OF DISLOCATIONS IN Zn SINGLE CRYSTALS BY THE ETCHING METHOD. V.R.Regel' and V.M.Stepanova.
Kristallografiya, Vol. 4, No. 2, 226-34 (March-April 1959). In Russian.

Experiments on Zn single crystals illustrate the difficulties encountered in applying the etching method to indicate dislocations in metals, and it is emphasised that the results of such experiments must be analysed critically. Photographs of etch figures produced on Zn by weak etchants (water, and alcoholic solutions of I) are reproduced and attention is drawn to the unusual figures obtained with water. It is shown that some weak etchants indicate defects only on freshly cleaved planes.

R.F.S.Hearmon

539.2 : 548.7

714 SIMPLE GRAPHICAL METHOD OF DRAWING AND INTERPRETING PARALLEL PLANES THROUGH A UNIT CRYSTAL CELL FOR ANY GIVEN SET OF MILLER INDICES. G.B.Savitsky.
Amer. J. Phys., Vol. 28, No. 1, 12-16 (Jan., 1960).

It is shown that a graphical method can provide a rapid analysis of parallel planes in various crystal structures. This method can be used to answer questions regarding relative distances between planes and whether planes with a given set of Miller indices are equivalent, as well as to determine the relative populations of each type of atom in nonequivalent planes. This in turn enables one to make some immediate inferences about X-ray scattering intensities for various orders of reflection without recourse to complicated mathematical analysis. The method involves a construction of a projectional diagram in accordance with some simple rules, which are illustrated with reference to a cubic unit cell for CaF_2, and then generalized to crystal structure of any other type.

539.2 : 548.7

715 THE INVERSE MATRIX OF NON-LINEAR LATTICE STATICS FOR KCl. H.Gross and F.Wahl.
Z. Naturforsch., Vol. 14a, No. 3, 285-94 (March, 1959). In German.

Continues previous work (see Abstr. 5080 of 1955; 6267 of 1959) on the inverse matrix for the linear part of the classical lattice equations aimed at the calculation of crystal defects. In this paper the matrix is determined for KCl. It is claimed that a consideration of electron shell polarization shows a substantial correction.

J.W.Leech

539.2 : 548.73

716 CAMERA FOR PHOTOGRAPHING X-RAY DIAGRAMS AT LOW AND HIGH TEMPERATURES (TRK). A.K.Shevelëv and L.M.Balakina.
Kristallografiya, Vol. 4, No. 2, 247-8 (March-April, 1959). In Russian.

The camera can be used from -190°C (obtained with liquid N) to 600°C (obtained by means of a tubular furnace), and can be evacuated. A detailed drawing and description is given.

R.F.S.Hearmon

539.2 : 548.73

717 DISLOCATIONS AND THEIR EFFECT ON X-RAY DIFFRACTION. L.F.Vassamillet.
Nuovo Cimento, Vol. 13, No. 6, 1133-42 (Sept. 16, 1959).

The problem of understanding the effect of dislocations on the diffraction of X-rays still remains largely unresolved. The treatments by Wilson and Suzuki and Willis have not been verified experimentally. However it is possible to show that the line profile derived from an extract treatment is qualitatively in agreement with that obtained by the Stokes–Wilson approximation. The approximate treatment can be extended to the case of an edge dislocation. When this is done, it is found that the "tail" of the line profile is not dependent on the dislocation type or orientation. It is also possible to show that the integral breadth, which is also obtained with the approximate treatment, is strongly dependent on the boundary conditions assumed for the cylindrical crystal. Consequently, the results obtained from a consideration of a single isolated dislocation would not appear applicable to an aggregate of dislocations in a real crystal.

539.2 : 548.73

718 X-RAY SCATTERING IN SOLIDS WITH IRREGULAR STRUCTURE. P.Debye.
Z. Phys., Vol. 156, No. 3, 256-64 (1959). In German.

It is shown how small-angle scattering can be used to get information on the gross structure of a non-crystalline medium. Explicit formulae are derived for the special case of a gel with hole structure, where X-ray analysis would be appropriate. The scattering intensity is expressed in terms of a correlation function C(r) which determines, by C'(0), the specific surface of the gel. If the hole sizes are random, the correlation function takes on an analytic form of a simple exponential, containing a correlation length a. This correlation length can be measured directly by observing the angular distribution of the scattering intensity.

539.2 : 548.73

719 THE CLEAVAGE SURFACES OF TYPE I AND TYPE II DIAMONDS. E.M.Wilks.
Phil. Mag. (Eighth Ser.), Vol. 3, 1074-80 (Oct., 1958).

The cleavage surfaces of 75 type I and 75 type II diamonds were examined using microscopy and multiple-beam interferometry. The work confirms an earlier qualitative observation that the surface of a type II diamond exhibits a more regular cleavage pattern. There are in general, more cleavage lines on type I diamonds, and also a greater number of the so-called river systems. The results suggest that impurities within the lattice lead to a more broken substructure in the type I diamonds. It is also shown that birefringence and counting properties are not appreciably reflected in the cleavage patterns, and that very few type II diamonds show evidence of a laminated structure.

539.2 : 548.73

720 THE STRUCTURE OF Au_2Mn. E.O.Hall and J.Royan.
Acta cryst., Vol.12, Pt 8, 607-8 (Aug., 1959).

The lattice is tetragonal with $a_0 = 3.363$ A; $c/a = 2.555$. Mn atoms lie on a body-centred lattice, and Au–Mn–Au groups lie along the c-axis. [See Herpin, Mériel, and Meyer, C.R.Acad. Sci. (Paris), Vol.246, No.22 3170-1 (June 2, 1958).]

A.R.Stokes

539.2 : 548.73

721 POLARITY OF GALLIUM ARSENIDE SINGLE CRYSTALS. J.G.White and W.C.Roth.
J. appl. Phys., Vol. 30, No. 6, 946-7 (June, 1959).

The polarity has been determined by the method of X-ray diffraction close to an absorption edge and the result has been correlated with that from a simple etching procedure. For the X-ray experiment BrKα and SeKα radiations were generated and the third order reflection obtained from the {111} and {$\bar{1}\bar{1}\bar{1}$} faces. The vectorial difference results from the series of double layers of gallium and arsenic atoms and the ratio of the reflected intensities of the two radiations from each face identifies the direction and face in which the gallium atoms are on the outside of the double layer. This face is the one on which etch pits were developed by etching for 10 min in 2 parts HCl, 1 part HNO_3 and 2 parts water.

W.Bardsley

539.2 : 548.73

722 SPACE GROUP SYMMETRY OF $K_2Cr_2O_7$. G.Sivasankara Rao.
J. Indian Inst. Sci. A, Vol. 41, No. 3, 47-51 (July, 1959).

The method of intensity statistics of X-ray reflections has been employed to resolve the controversy about the space group of the triclinic room temperature form of $K_2Cr_2O_7$. Intensity distribution curves definitely indicate the presence of a centre of symmetry showing that the crystal belongs to the space group P1.

539.2 : 548.73

723 CRYSTAL STRUCTURE OF Re_2S_7. K.Traore and J.P.Brenet.
Bull. Soc. Franc. Mineral. Crist., Vol. 82, No. 7-9, 323 (July-Sept., 1959). In French.

539.2 : 548.73

724 CRYSTAL STRUCTURES OF Zr Be_5 AND Zr_2 Be_{17}. A.Zalkin, R.G.Bedford and D.E.Sands.
Acta cryst., Vol.12, Pt 9, 700 (Sept., 1959).

Powder mixtures of Zr and Be were heated to 1600°C, powdered again and reheated. X-ray examination showed the existence of two new phases, $ZrBe_5$ and Zr_2Be_{17}. $ZrBe_5$ is hexagonal with cell dimensions $a = 4.564 \pm 0.002$, $c = 3.485 \pm 0.002$ A, space group P6/mmm, and calculated density 3.60 g/cm^3. The atomic positions and interatomic distances are also given. Zr_2Be_{17} has a rhombohedral cell with $a = 5.694 \pm 0.005$ A, $\alpha = 83.02 \pm 0.02°$, space group R$\bar{3}$m and calculated density 3.081 g/cm^3.

R.F.S Hearmon

539.2 : 548.74

725 INVESTIGATION OF THE RECIPROCAL LATTICE OF SINGLE CRYSTALS BY MEANS OF KIKUCHI PATTERNS. W.D.Riecke and Y.Sakaki.

Z. Phys., Vol. 156, No. 3, 534-54 (1959). In German.

The Kikuchi bands belonging to a zone axis may be used to locate the lattice points lying within the reciprocal lattice plane, which is orthogonal to this axis and passes through the origin. For the investigation of the whole reciprocal lattice, a series of reflection patterns is taken at different orientations of the specimen. Each group of Kikuchi bands belonging to a zone axis is used to locate the reciprocal lattice points in a section orthogonal to the respective zone axis. The angles between the section planes are obtained by recording the angle of rotation between successive exposures and by considering the inclinations of the zone axes relative to the primary beam. In a perspective drawing the reciprocal lattice region near the origin is then composed of these sections.

539.2 : 537.533

FORMULATION OF ELECTRON DIFFRACTION BY MEANS OF A SCATTERING MATRIX. See Abstr. 273

VARIOUS SOLID STRUCTURES

539.215 : 534.23

726 INFLUENCE OF GRAIN STRUCTURE ON ULTRASONIC ATTENUATION IN STEEL. E. P. Papadakis.
J. appl. Phys., Vol. 30, No. 9, 1463 (Sept., 1959).

A comparison is made between the predicted and experimental values of the attenuation of longitudinal waves (15 Mc/s) in martensite, bainite and iron. J. Jarzynski

539.219

727 THE GREY TIN ⇌ WHITE TIN TRANSITION IN TIN–MERCURY ALLOYS. R.W.Smith.
Canad. J. Phys., Vol. 37, No. 10, 1079-84 (Oct., 1959).

The characteristics of the transition between white tin (β) and the grey modification (α) in zone-refined tin containing various amounts of mercury have been investigated. From dilatometric measurements, it is shown that the transition temperature of the reaction: β(tin–mercury alloy) ⇌ grey tin + mercury is $-8.15^{0} \pm 0.1^{0}$C. Above this temperature, mercury will attack grey tin to form a white tin amalgam. The compound $HgSn_{12}$, previously reported not to undergo transformation, is shown to transform below this temperature. Measurements are given of the rates of growth of islands of grey tin on the surfaces of a number of tin–mercury alloys at -30^{0}C. These indicate that the rate of $\beta \rightarrow \alpha$ transformation is virtually independent of the mercury content of the alloy. The results are discussed and a mechanism is advanced to account for the large displacement of the $\alpha \rightleftharpoons \beta$ transition temperature observed when mercury is alloyed with tin in contrast to the small changes brought about by other additions.

539.219

728 THE VARIATIONS OF INTERATOMIC BOND STRENGTH IN A SINGLE-PHASE SOLID SOLUTION OF NICKEL AND ALUMINIUM.
G.V.Kurdyumov, V.K.Kritskaya, P.A.Lataiko and Yu.A.Osip'yan.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 1, 76-8 (Jan. 1, 1959).
In Russian.

This paper describes elasticity measurements on an alloy with 8.3 atomic percent Al, after various sequences of quenching and annealing, and refers to Kurdyumov's earlier discussion of iron alloys and nichrome alloys, which these results are believed to support [Zh. tekh. Fiz., Vol. 25, 183 (1955); Dokl. Akad. Nauk SSSR., Vol. 102, 271 (1955)]. They postulate a redistribution of atoms in the lattice, evoking a transition between two electronic configurations, for which the elasticity is regarded as an index. The data show two well-defined temperatures associated with the changes in elasticity (300°, 700°C). No change was found in lattice parameters. A difference in microstructure was however observed, and is illustrated by a pair of micrographs. [The possibility of twinning is not mentioned, despite strongly significant features of these pictures]. Analogous results were found with a copper-nickel alloy, but the data are not reported. I.D.C.Gurney

539.219

729 SOLID SOLUTIONS IN THE ZINC SELENIDE–GALLIUM ARSENIDE SYSTEM.
N.A.Goryunova and N.N.Fedorova.
Fiz. tverdogo Tela, Vol. 1, No. 2, 344-5 (Feb., 1959). In Russian.

The existence of a continuous series of solid solutions in the ZnSe–GaAs system was confirmed by the results of metallographic examination, micro-hardness measurements, and X-ray diffraction analysis. M.H.Sloboda

539.219

730 EQUILIBRIUM SOLID SOLUTIONS IN THE InSb–GaSb SYSTEM. V.I.Ivanov-Omskii and B.T.Kolomiets.
Fiz. tverdogo Tela, Vol. 1, No. 6, 913-18 (June, 1959). In Russian.

Deals with the possibility of formation of a continuous series of substitutional solid solutions in InSb–GaSb. It was found such solid solutions can be prepared by zone melting, employing low rates of motion (1-3 mm/hr) of the molten zone and a large number of zone passages. A preliminary indication of the electrical properties is given by electron mobility higher than 3×10^{4} $cm^{2}V^{-1}sec^{-1}$ in a 3InSb.GaSb sample. A.Tybulewicz

539.219 : 536.7

731 FEATURES OF THE THERMODYNAMICS OF SOLID SOLUTIONS. N.S.Fastov.
Fiz. Metallov i Metallovedenie, Vol. 7, No. 3, 354-9 (1959).
In Russian.

Discusses the application of thermodynamics to systems not quite in equilibrium — in particular, to stressed solids. Formulae are derived for: the equilibrium concentration of vacancies; the elasticity of the saturated vapour of a solid solution; and the saturation concentration of a solid solution. Results and methods are compared with the corresponding thermodynamic treatment of liquids. A.F.Brown

539.219 : 537.3

732 SOME QUANTITATIVE RELATIONSHIPS OF THE PROCESS OF DONOR–ACCEPTOR INTERACTION IN METALLIC ALLOYS.
I.N.Frantsevich, D.F.Kalinovich, I.I.Kovensky and M.D.Smolin.
Fiz. tverdogo Tela, Vol. 1, No. 1, 62-6 (1959). In Russian.

Formulae were derived for determining the transport number, n, and the ionic charge, z, of an ion of a given element. Both z and n were calculated for C, Fe, Cr, Mo, and W, present as alloying additions in the Fe–C, Fe–Cr, Fe–Mo, and Fe–W systems. It was shown that z of C, Cr, and Mo in binary Fe alloys does not change in the 900-1150°C range, and that n of these elements, calculated from the mean values of z, increases with rising temperature. Both z and n of Mo increase with increasing concentration of this element in the Fe–Mo alloy. The results obtained were taken to indicate that the donor or acceptor character of the components of solid metallic solutions can be unequivocably determined by studying the electrical transport phenomena. M.H.Sloboda

539.23

733 FORMATION OF TWINS BY CONDENSATION OF A METALLIC VAPOUR ON THE (111) FACE OF A SINGLE CRYSTAL OF COPPER. I. DEPOSITION OF COPPER.
L.Lafourcade, P.Larroque and Nguyen Quat Ti.
C.R. Acad. Sci. (Paris), Vol. 249, No. 2, 230-2 (July 15, 1959).
In French.

The (111) face of a single crystal of copper was cleaned in the diffraction camera by ion bombardment. Copper was then evaporated on to the surface at a known angle of inclination. It was found that epitaxial growth was a function of this angle. Twinning increases strongly at oblique angles to the crystal surface. A.E.I. Research Laboratory

539.23

734 FORMATION OF TWINS BY CONDENSATION OF A METALLIC VAPOUR ON A (111) FACE OF A SINGLE CRYSTAL OF COPPER. GOLD DEPOSTION.
L.Lafourcade, P.Larroque and Nguyen Quat Ti.
C.R. Acad. Sci. (Paris), Vol. 249, No. 3, 390-1 (July 20, 1959).
In French.

See preceding abstract. Reports further work on the formation of twins as revealed by electron diffraction during the evaporation of metallic vapour onto the surface of a single crystal. The results confirm earlier measurements.

A.E.I. Research Laboratory

539.23

735 A FURTHER CONTRIBUTION ON THE STRUCTURE OF THIN LAYERS OBTAINED BY EVAPORATION OF INDIUM ANTIMONIDE IN VACUO. G.A.Kurov.
Fiz. tverdogo Tela, Vol. 1, No. 1, 172-3 (1959). In Russian.

New arguments are presented to support the author's assertion (Abstr. 2680 of 1958) that the vacuum-deposited — supposedly InSb

— films obtained by Konozenko and Mikhnovskii [Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 20, No. 12, 1486 (1956)] consisted, in fact, of pure Sb. M.H.Sloboda

539.23

736 METHOD OF PREPARING THIN FILMS OF ALLOYS SUITABLE FOR OPTICAL STUDIES. L.G.Schulz.
J. Opt. Soc. Amer., Vol. 49, No. 12, 1191-5 (Dec., 1959).

An experimental procedure is described for producing thin films of binary alloys by evaporation and condensation in a vacuum. The components of the desired alloy are evaporated successively and the alloy is then produced by diffusion. A feature of the method is the use of a rotating modulator located between the vapour source and the substrate which controls the relative thickness of the deposit. During the first evaporation a uniform gradient of one metal is deposited. The substrate is then rotated 180° in its own plane and a gradient of another material is superposed. This results in a sample of approximately uniform thickness with pure metal components at the ends and with a composition gradient in between. The procedure is easily extended to permit the production in one evaporation of several samples having different thicknesses. An annealing treatment is usually helpful in promoting diffusion. Representative results on several alloys are described.

539.23

737 METHOD FOR OBTAINING UNIFORM EVAPORATED LAYERS. M.V.Schneider.
J. Opt. Soc. Amer., Vol. 50, No. 1, 18-21 (Jan., 1960).

Evaporated metal layers with a high uniformity may be obtained by using a system of parallel wires as evaporation source. The distribution of the film thickness is discussed for a simple system of two parallel wires. If the two wires are properly spaced with respect to the receiving surface a maximally flat distribution of film thickness may be obtained. A special example of a system with 12 parallel wires is treated in detail. The method has been used for producing thin films for precision microwave attenuators as well as for semitransparent and dissipative devices in the microwave range.

539.23

738 INVESTIGATION OF CRYSTALLIZATION OF ANTIMONY IN THIN FILMS. II. INFLUENCE OF DIFFERENT SUBSTRATES. L.S.Palatnik and V.M.Kosevich.
Kristallografiya, Vol. 4, No. 1, 42-6 (1959). In Russian.

In Pt I, see Kristallografiya, Vol. 3, No. 6, 709-15 (1958). Crystalline substrates for the crystallization of Sb can be divided into 3 groups: (1) substrates of Sb, Bi, Au and Ag on which the Sb is deposited in the crystalline phase; (2) substrates of KBr, KCl, KI, NaCl, Cr, Al, Be and mica, on which the Sb is deposited in the amorphous phase provided the Sb film is less than a certain critical thickness, otherwise the Sb crystallizes by the growth of spherulites; (3) substrates of Fe, Sn, Pb, Cu and Mn on which the deposition of Sb is intermediate between the first two types. The effect of oxide films and the connection between crystal orientation in the substrate and in the film is also discussed. R.F.S.Hearmon

539.23

739 ELECTROLYTIC PREPARATION OF FILMS OF IRON OF THICKNESS 20 TO 50 A. A.Politycki and E.Fuchs.
Naturwissenschaften, Vol. 46, No. 10, 351 (1959). In German.

Describes how thin layers of Fe may be produced, using a Cu substrate which is subsequently dissolved away, by the method previously described for Ni layers [Pfisterer, Politycki and Fuchs, Naturwissenschaften, Vol. 45, No. 12, 282 (1958)]. The bath used consisted of 240 g/l $FeCl_2.4H_2O$ and 180 g/l of KCl. Oxide formation is also discussed. J.Thewlis

539.23 : 535.39

740 OPTICAL MEASUREMENTS ON THIN FILMS OF CONDENSED GASES AT LOW TEMPERATURES. J.Kruger and W.J.Ambs.
J. Opt. Soc. Amer., Vol. 49, No. 12, 1195-8 (Dec., 1959).

A determination of the refractive indices of thin films of oxygen, nitrogen, carbon dioxide, water, argon, neon, and krypton condensed at 4.2°K was made. These were obtained for the 5461 A line of Hg with an ellipsometer. Similar measurements were also made on films of these gases condensed after passage through a microwave discharge. With the exception of N_2 and Kr, measurable differences in refractive indices were observed between films condensed from discharged and undischarged gases.

539.23 : 535.51

CLEANING Al EVAPORATED MIRRORS. ELIMINATING POLARIZATION EFFECTS. See Abstr. 178

X-ray and Electron Microscope Examination

539.27

741 THE FORMATION OF CARBON FILMS ON ELECTRON MICROSCOPICAL PREPARATIONS. E. Zehender.
Optik, Vol. 16, No. 9, 522-6 (Sept., 1959). In German.

During irradiation by electrons, a carbon film is formed on objects in an electron microscope. The speed of formation of this film depends upon the beam density at the object, the temperature of the object carrier, and the partial vapour pressure of the hydrocarbons inside the microscope. It is shown that the manner of illumination as well as the geometry of the object carrier are of importance in the carbonization. The use of small stops and narrow illumination channels in front of the objective considerably increase the speed of formation of the carbon layer.

539.27

742 THE DECOMPOSITION OF MAGNESIUM HYDROXIDE IN AN ELECTRON MICROSCOPE. J.F.Goodman.
Proc. Roy. Soc. A, Vol. 247, 346-52 (Sept. 30, 1958).

The beam of an electron microscope was used to dehydrate single crystals of magnesium oxide. Electron diffraction photographs and electron micrographs were taken at various stages to follow the crystallographic and morphological changes which accompany decomposition. The decomposition may be considered to occur in two stages. First, there is a small shrinkage in the basal plane, and the resulting strain causes a maze of cracks in the crystal. This change is followed by a collapse of the planes down the original [0001] of magnesium hydroxide. The collapse is controlled by the migration of water molecules from between the planes to a surface where they can escape. The product is a highly oriented aggregate of micro-crystallites of magnesium oxide. More intense irradiation in the electron beam occasionally causes bulk movement of the solid.

539.27

743 ELECTRONMICROSCOPIC OBSERVATION OF THE ADDITIVELY COLOURED KCl CRYSTAL. II. EFFECTS OF LIGHT EXPOSURE. T.Hibi and T.Tomiki.
Sci. Rep. Res. Insts Tohoku Univ. A, Vol. 11, No. 3, 264-70 (June, 1959).

For Pt I, see Abstr. 12798 of 1959. The effects of light exposure on the fresh cleavage plane of a single crystal, containing only F-centres, were examined by means of a replica technique. The observation indicates that the light exposed surface shows interesting changes. The mechanism by which they are induced is discussed briefly.

PHYSICAL CHEMISTRY

THERMOCHEMISTRY . REACTIONS

541.12 : 536.75

744 ENTROPY PRODUCTION IN A SPONTANEOUS; ADIABATIC (NON-ISOTHERMAL) CHEMICAL REACTION. D.H.Everett.
Canad. J. Chem., Vol. 37, No. 11, 1911-15 (Nov., 1959).

When a chemical reaction occurs spontaneously and isothermally the loss of useful work is equal to the decrease in free energy of the system. If the same reaction, supposed for example to be exothermic, occurs adiabatically the temperature rises and the system can be used as a source of heat to operate a heat engine: as heat is withdrawn the temperature of the system falls and eventually returns to its initial value. Part of the free energy of the reaction has been recovered as useful work, part lost in the spontaneous irreversible step. Expressions are derived for the loss of useful work and the entropy production in the adiabatic irreversible step, and it is shown that the work lost is equal to $T_0 \times$ (entropy produced) where T_0 is the temperature of the surroundings. Some consequences of these ideas in relation to the definition of the efficiency of internal combustion engines are considered briefly.

541.12

745 TRITIUM—ETHANE REACTION. P.L.Gant and K.Yang.
J. chem. Phys., Vol. 30, No. 4, 1108-9 (April, 1959).

To elucidate the mechanism of this reaction in which labelled ethane, propane, and n-butane are formed, 10% NO was added to the ethane—tritium mixture. The rate of formation of labelled ethane decreased to 77% of the uninhibited rate while formation of propane and n-butane was almost completely inhibited. Two types of reactions are proposed to account for the data, one involving thermalized free radicals. W.Good

541.12

746 ISOMERIZATION OF PRIMARY N-ALKYL FREE RADICALS. A.S.Gordon and J.R.McNesby.
J. chem. Phys., Vol. 31, No. 3, 853-5 (Sept., 1959).

The reaction of methyl radicals with ethylene has been studied at various temperatures. It is thought that propylene, the chief product of the reaction at all the temperatures studied, is formed by a mechanism of intramolecular abstraction followed by pyrolysis of the resulting radical. G.I.W.Llewelyn

541.12

747 COMPLEX CHEMICAL EQUILIBRIA BY MINIMIZING FREE ENERGY. L.M.Naphtali.
J. chem. Phys., Vol. 31, No. 1, 263-4 (July, 1959).

This is done by a technique which does not need the ideal gas assumption and which avoids the problems of convergence and other shortcomings to be found in older techniques. A programming scheme for a computer is given. W.Good

ELECTROCHEMISTRY

541.13 : 539.18

748 THE ELECTROLYTIC HYDROGEN—DEUTERIUM SEPARATION FACTOR AND REACTION MECHANISM. B.E.Conway.
Proc. Roy. Soc. A, Vol. 247, 400-19 (Sept. 30, 1958).

The theory of the electrolytic separation factor (S) for H and D is examined for various rate-determining mechanisms in the cathodic hydrogen evolution reaction. Isotopic differences of all relevant thermodynamic quantities and partition functions for the reacting entities are taken into account in the calculation of rates of pairs of isotopically analogous reactions. Values of S characteristic of various mechanisms and conditions are obtained and it is shown that the value arising if electrochemical desorption of adsorbed H or D is rate determining, is 6.1 whilst that for simple discharge of hydroxonium ions is 3.0. The experimental data for S are readily divisible into two groups having, respectively, values close to these two figures. The values of S predicted theoretically for selected metals, assuming the rate-determining mechanism indicated by independent experimental criteria, are in agreement with the values of S measured experimentally for these metals. S is examined as a function of D_2O content of the solution in limiting cases. The ratio of rates of D and H production from solutions in pure D_2O or H_2O, respectively, is characteristic of reaction mechanism. Anomalies in the theory of proton discharge and isotope separation from alkaline solution are discussed.

PHOTOCHEMISTRY RADIATION CHEMISTRY

541.15

749 THE EXCHANGE OF HYDROGEN AND DEUTERIUM IN THE PRESENCE OF ELECTRONS AND ULTRAVIOLET RADIATION. O.A.Schaeffer and S.O.Thompson.
Radiation Research, Vol. 10, No. 6, 671-9 (June, 1959).

A mechanism for the radiation-induced exchange of H_2 and D_2 in the presence of rare gases is proposed. It involves H_3^+ as the ion chain carrier, inhibition by rare gas R occurring as a result of formation RH^+. Moderate and marked inhibition are caused by reaction with H_2^+ and with H_3^+ respectively. He, Ne and A cause moderate inhibition at moderate concentrations; Kr and Xe cause marked inhibition even at trace concentrations. For the former, the reaction $R^+ + H_2 \rightarrow RH^+ + H$ followed by $RH^+ + H_2 \rightarrow R + H_3^+$ is energetically possible. With simultaneous ultraviolet and electron irradiations, there is interaction between ion and radical reactions. The presence of H atoms inhibits the ion reaction. The reaction may terminate by neutralization of ion molecule clusters with free electrons. C.B.Allsopp

DISPERSIONS . COLLOIDS ADSORPTION

541.18

750 THE INFLUENCE OF TEMPERATURE ON THE KINETICS OF CHEMISORPTION OF HYDROGEN ON ZINC OXIDE. M.J.D.Low.
Canad. J. Chem., Vol. 37, No. 11, 1916-22 (Nov., 1959).

The kinetics of hydrogen adsorption by ZnO have been measured at constant pressures of 403 mm Hg over temperatures from 0° to 257°C. Two distinct consecutive kinetic stages occur at all temperatures, each stage being precisely expressed by the Elovich equation. The rates and extents of adsorption increase in the temperature ranges 0-80°C and 110-200°C and decrease in the range 80-110°C. The change with temperature of the constants a and $1/\alpha$ of the Elovich equation parallels changes in the amount adsorbed with temperature.

541.18

751 ADSORPTION OF CARBON DIOXIDE ON TUNGSTEN. D.O.Hayward and R.Gomer.
J. chem. Phys., Vol. 30, No. 6, 1617 (June, 1959).

Previous results of the authors are adduced and suggest that CO_2 is dissociated into CO and O on a tungsten surface. They offer also an explanation for the high heat of adsorption of CO_2 on tungsten films (O and CO are strongly bound). W.Good

541.18

752 THE RATES OF ADSORPTION OF WATER AND CARBON MONOXIDE BY ZINC OXIDE. M.J.D.Low and H.A.Taylor.
J. phys. Chem., Vol. 63, No. 8, 1317-18 (Aug., 1959).

Measurement of the adsorption of CO on ZnO ex oxalate has shown that it is irreversible. Below 100°C the adsorption was apparently complete after a few minutes. At 100°C, a slow adsorption followed the rapid adsorption, while above 100°C only a slow adsorption was found. With water vapour, a slow and decelerating pressure

change followed every sudden alteration of pressure. This suggested extensive ad- and desorption of water by the glass tubing of the system. The rates and extents of water adsorption by ZnO were greatly decreased by pre-adsorbed hydrogen. R.Schnurmann

541.18

753 FIRST ADSORBED LAYER OF NITROGEN ON PYREX AT 77.4° K. J.P.Hobson.
Canad. J. Phys., Vol. 37, No. 10, 1105-13 (Oct., 1959).

A measure of the nitrogen adsorption isotherm on pyrex (Corning 7740) at 77.4° K was made for pressures above the adsorbed layer ranging from 10^{-3} to 10^{-9} mm Hg. Ultrahigh-vacuum techniques were used. Geometric adsorbing areas were 60 and 32 cm^2. Coverages ranged approximately from 0.001 to 0.3 monolayer. Full equilibrium was probably not achieved but the data could be represented by the Dubinin–Radushkevich equation,

$$\log \sigma = C - D\left(\log \frac{P}{P_0}\right)^2,$$

for P/P_0 from 10^{-6} to 10^{-11}, where σ is the amount adsorbed.

541.18 : 534.39

COAGULATION OF AEROSOLS IN U.S. FIELD.
See Abstr. 139

GEOPHYSICS

550.3 : 621.3

754 THE FIFTIETH KELVIN LECTURE "THE INTERNATIONAL GEOPHYSICAL YEAR 1957-58". D.Brunt.
Proc. Instn Elect. Engrs, Paper 3035, publ. Sept., 1959 (Vol. 106B, 437-43).

550.3

755 MAGNETIC ACTIVITY FOLLOWING A SOLAR FLARE. R.A.Watson.
J. atmos. terrest. Phys., Vol. 11, No. 1, 59-61 (1957).

Evidence is examined which suggests that either there is no increase of magnetic activity due to a solar flare or that the increase is a very rare event.

550.3 : 539.37

THE DISPLACEMENT FIELD DURING TOTAL RUPTURE IN AN ELASTIC MEDIUM. See Abstr. 699

550.8 : 537.3

SCALE OF POTENTIAL PRODUCED IN A HOMOGENEOUS MEDIUM BY A RECTANGULAR IMPULSE. See Abstr. 237

ATMOSPHERE . IONOSPHERE

(Abstracts on radiowave propagation in ionized media will also be found under Electromagnetic Waves)

551.5

756 THE RESOLVING ANEMOMETER. I.Karmin.
Bull. Amer. Meteorol. Soc., Vol. 40, No. 9, 473-6 (Sept., 1959).

Available techniques were adapted to design an anemometer which records its output in digital form. The digital output from the anemometer permits rapid analysis of the data and also enables unattended operation of the instrument from a battery supply. It records wind speeds from 2.5 to 25 miles/hr and records wind directions within 5 deg of the true wind directions.

551.5 : 535.42

757 DIFFRACTION MICROSCOPY AND THE IONOSPHERE. G.L.Rogers.
J. atmos. terrest. Phys., Vol. 10, No. 5-6, 332-7 (1957).

The application of diffraction microscopy to Mitra records is considered. It is shown that its application to existing records might result in some slight improvement, probably scarcely justifying the effect. If, however, tests should show that the combination would work with aerial spacings of 3-10 λ, the advantages of the combined method would be substantial. The question of future development is briefly touched on.

551.5 : 535.42

758 AN EXPERIMENTAL VERIFICATION OF DIFFRACTION MICROSCOPY, USING RADIO WAVES. G.L.Rogers.
J. atmos. terrest. Phys., Vol. 11, No. 1, 51-3 (1957).

An aircraft has been deliberately flown over the receivers of a station during Mitra recording. The contribution of the aircraft to the Mitra pattern has been isolated by diffraction microscopy, and a one-dimensional "image" of it has been recovered. The location of this image on the optical bench is in satisfactory agreement with the theory.

551.5 : 538.56

759 THE CONNECTION BETWEEN IONOSPHERIC PATTERNS AND FIELD STRENGTHS REFLECTED ON THE GROUND. J E.Drummond.
J. atmos. terrest. Phys., Vol. 9, No. 5-6, 282-94 (1956).

If the ionosphere is regarded as a plane, patchy reflector, it can be shown by using Doppler shift theory and wave theory that drift and turbulent processes with periods less than $\lambda/2 \sin \alpha$ (λ is the radio wavelength and 2α is the angle subtended by the reflecting area on the ground) do not produce patterns on the ground and other short-length processes are attenuated. The correlogram of the reflected signal is also correspondingly modified, and some ionospheric observations are examined in the light of this theory.

551.5

760 THE ELECTRON CONTENT OF THE IONOSPHERE. J.V.Evans.
J. atmos. terrest. Phys., Vol. 11, No. 3-4, 259-71 (1957).

The investigation of the long period fading of radio echoes from the moon has provided a new technique for the measurement of the total electron content of the ionosphere (Browne et al., 1956). This method is based on the measurement of the rotation of the plane of polarization of the radio waves produced by the magneto-ionic effect in the earth's ionosphere. Some preliminary results (Evans, 1956) indicated that the total electron content is approximately twice that which would be expected on the basis of a simple parabolic layer from p'f data. A brief account of the technique is given together with a description of the method of analysing the records. The ratio between the observed electron content and that in the parabolic model was always in the region of 2 : 1. The diurnal variation of the total ionospheric electron content appears not to be completely regular, which is suggestive of tidal effects.

551.5

761 THE CALCULATION OF IONOSPHERIC ELECTRON DENSITY DISTRIBUTIONS. J.M.Kelso.
J. atmos. terrest. Phys., Vol. 10, No. 2, 103-9 (1957).

A method is given for calculating the vertical distribution of electrons in an ionosphere in the presence of the earth's magnetic field. The data required are obtained from experimental records of group height as a function of frequency. The usual restriction to montonic layers applies. The general procedure is an iteration method which makes it possible to correct a first approximation to yield improved results. Two methods are given. The first, an integral equation method, obtains the first approximation by solving the integral equation for true height in the absence of the earth's magnetic field. The second, or parabolic layer method, is the more efficient of the two, and makes use of a generalized form of the Appleton–Beynon method to get a parabolic layer as a first approximation.

551.5

762 A CRITICAL DISCUSSION ABOUT SPECIAL IONOSPHERIC CHARACTERISTICS. R.Eyfrig.
J. atmos. terrest. Phys., Vol. 11, No. 3-4, 163-76 (1957).

A series of examples prove that the present measurements of the characteristic (M 3000) F2 have an unambiguous relation with change of the solar activity, but only for limited regions on the earth. M values as reported at present by different stations are partly insufficient and even too contradictory to justify a worldwide examination. The importance of accuracy of both height and MUF measurements has been specially stressed, because of the geophysical year.

551.5

763 NIGHT-TIME IONIZATION IN THE LOWER IONOSPHERE. I. RECOMBINATION PROCESSES. A.P.Mitra.
J. atmos. terrest. Phys., Vol. 10, No. 3, 140-52 (1957).

Both height and time variations of the effective recombination coefficient at night for the lower ionosphere are obtained from ionospheric data, including measurements on ionospheric absorption at 18.3 Mc/s and 150 kc/s; hourly values of the night-time E-region critical frequencies for Watheroo, phase height observation at 16 kc/s, and virtual height measurements at 50 kc/s and 150 kc/s. It is found that although at levels near 80 km the effective recombination coefficient increases appreciably immediately after sunset, at higher levels the coefficient decreases. Theoretical interpretation of these results is based on the idea put forward by Nicolet, that an appreciable number of atomic ions of low ionization potential exist in the lower ionosphere. While the positive molecular ions disappear rapidly through dissociative recombination with electrons, the positive atomic ions disappear very slowly.

551.5

764 NIGHT-TIME IONIZATION IN THE LOWER IONOSPHERE. II. DISTRIBUTION OF ELECTRONS AND POSITIVE AND NEGATIVE IONS. A.P.Mitra.
J. atmos. terrest. Phys., Vol. 10, No. 3, 153-62 (1957).

The distributions of various positive and negative ions and of electrons in the lower ionosphere at night are deduced from previous observational results. The positive ions are the atomic ions X^+, which are only predominant at night, and the molecular ions YZ^+ that control the daytime ionization. It is found that the concentration of X^+ increases from a negligible value at about 87 km to about $7 \times 10^3/cm^3$ at 110 km. While the concentration of negative ions decreases with the progress of the night, the ratio of the concentration of negative ions and electrons remains constant. There is, however, a rapid fall of this ratio from 80 to 110 km by a factor of about 7×10^{-4}.

551.5

765 DIURNAL ABSORPTION IN THE D-REGION. J.W.Warwick and H.Zirin.
J. atmos. terrest. Phys., Vol. 11, No 3-4, 187-91 (1957).

The diurnal variation of cosmic noise was analysed at a frequency of 18 Mc/s From these records are derived the electron density as a function of local time and height in the D-region, and a one-parameter, exponential approximation to the vertical distribution of the ionizable constituent, nitric oxide. The electron density curves fit those derived in different ways by other groups. The recombination coefficient, within the D-region, is predicted to be either constant, or to increase with height.

551.5

766 STUDIES OF THE E LAYER OF THE IONOSPHERE. I. SOME RELEVANT THEORETICAL RELATIONSHIPS. E.Appleton and A.J.Lyon.
J. atmos. terrest. Phys., Vol. 10, No. 1, 1-11 (Jan., 1957).

An extended investigation of the E layer of the ionosphere, using vertical-sounding data from many stations over the world, has identified a number of ways in which E layer behaviour is not adequately explained in terms of current theories of ionized layer formation and variation. The maximum ionization density in the E layer is supposed to assume quasi-stationary values over the hours of daylight, for which alone experimental measurements are generally available. Formulae have been developed expressing variations from the simple theory, based on possible alterations in the basic physical assumptions of accepted theory. Notable among these is the assumption that the E layer is influenced by vertical drift, behaving as a motor as well as a dynamo.

551.5

767 THE INFLUENCE OF SOLAR FLARES ON THE IONOSPHERIC E LAYER. J.Taubenheim.
J. atmos. terrest. Phys., Vol. 11, No. 1, 14-22 (1957). In German.

The enhancements of E-layer critical frequency connected with sudden ionospheric disturbances are quantitatively discussed for a number of selected days. The increase of electron density lasts considerably longer than is deduced from the radio fadeout. A satisfactory estimate of the response of E-layer electron density to enhancements of the ionizing radiation is given by a solution of the ionospheric continuity equation for a very simple case. It follows that the observed variation of electron density is controlled decisively by the slow decrease of the radiation excess rather than by recombination. The magnitude of the enhancement of ionizing radiation can be calculated approximately.

551.5

768 CONVECTIVE DIFFUSION IN THE EQUATORIAL F REGION. J.W.Dungey.
J. atmos. terrest. Phys., Vol. 9, No. 5-6, 304-10 (1956).

This paper discusses the convective diffusion which Johnson and Hulburt showed could take place across the geomagnetic field in the F region near the equator. It is shown that the convective diffusion will increase any irregularities which may be present. The usual formula for the conductivity is found to be inappropriate when diffusion is involved. The convective motion is regarded as that of a gravity-driven dynamo and its speed is controlled by the current flowing along the lines of force into lower levels of the ionosphere. The speed is found to be inversely proportional to the east-west scale of the irregularities, and for a scale of 100 metres may be a few metres/sec.

551.5

769 THE ORIGIN OF THE IONOSPHERIC IRREGULARITIES RESPONSIBLE FOR RADIO-STAR SCINTILLATIONS AND SPREAD-F I. REVIEW OF EXISTING THEORIES. M.Dagg.
J. atmos. terrest. Phys., Vol. 11, No. 3-4, 133-8 (1957).

The present state of knowledge about the irregularities responsible for radio-star scintillations is summarized, and the existing theories of the origin of these irregularities are discussed. All of the suggestions are shown to be inadequate to explain the observed features of scintillations and spread F. It is shown that any ionizing agent from outside the earth's atmosphere is unlikely to be responsible for the ionospheric irregularities that cause radio-star scintillations, and that the mechanism for their production must be sought in the terrestrial atmosphere.

551.5

770 THE ORIGIN OF THE IONOSPHERIC IRREGULARITIES RESPONSIBLE FOR RADIO-STAR SCINTILLATIONS AND SPREAD-F II. TURBULENT MOTION IN THE DYNAMO REGION. M.Dagg.
J. atmos. terrest. Phys., Vol. 11, No. 3-4, 139-50 (1957).

A theory is presented which attributes the occurrence of ionospheric irregularities in the F-region to turbulent wind motion in the dynamo region at a height of 110-150 km. The resulting turbulent component of the electric potential field produced is communicated to the F-region as suggested by Martyn (1955), where magneto-electric forces then cause the ionization to form eddies. It is suggested that the absence of daytime scintillations is due to the inhibition of turbulent flow by large temperature gradients during the day. The theory is then compared in detail with observations and shown to be capable of explaining all the major features of radio-star scintillations, together with such diverse results as the long-term correlations of scintillation amplitude with magnetic activity and the variation in the occurrence of spread-F and scintillations at different parts of the earth over the sun-spot cycle.

551.5

771 BIFURCATIONS IN THE F-REGION AT BAGUIO, 1952-1957. V.Marasigan.
J.atmos.terrest. Phys., Vol.13, No.1-2, 26-31 (1958).

A 5-year statistical survey of bifurcations in the F-region at Baguio presented and analysed in the light of a parametric mechanism of the v-R relations of the F1- and F2-layers. The conclusion is reached that two of the features of bifurcation-statistics are mainly due to variations in layer heights and thicknesses with season and solar activity respectively.

551.5

772 MEASUREMENT OF THE GYRO-FREQUENCY IN THE F REGION. G.R.Ellis.
J. atmos. terrest. Phys., Vol. 11, No. 1, 54-8 (1957).

This paper describes a method of measuring the F-region gyro-frequency from P'f records, using the relation $f_H = f_X - f_Z$. The observed values of the critical frequencies must be corrected for errors arising from lateral deviation and horizontal gradients of critical frequency. It is shown that the lateral deviations of the O, X, and Z modes, calculated with an approximate value of f_H, and the observed values of f_X, f_O, and f_Z, provide sufficient information to obtain both the horizontal gradient of critical frequency and the gyro-frequency. The results of an analysis of P'f records obtained at Hobart, Tasmania, are given. It was found that at a mean true height of 378 km, the mean gyro-frequency was 1.53 Mc/s, compared with an extrapolated value, using ground parameters, of 1.40 Mc/s.

551.5

773 SELF-DISTORTION OF RADIO WAVES IN THE IONOSPHERE, NEAR THE GYRO FREQUENCY. F.H.Hibberd.
J. atmos. terrest. Phys., Vol. 11, No. 2, 102-10 (1957).

In a previous paper (Hibberd, 1956) the self-distortion (or self-interaction) of a low frequency radio wave in the ionosphere was considered, neglecting the earth's magnetic field, and it was shown that self-distortion results in a small reduction of the modulation depth of a modulated wave. The theory is extended here, with the inclusion of the magnetic field, for frequencies near the gyro frequency. It is shown that the reduction in modulation depth varies only slowly with wave frequency near the gyro frequency, and shows no resonant-like variation. The reduction is proportional to the power radiated, is greatest for low modulation frequencies and decreases rapidly as the modulation frequency is increased. With 100 kW radiated, the fractional reduction in modulation depth of a modulated gyro wave is expected to be of the order of 1 part in 100.

551.5

774 RADIO STAR SCINTILLATIONS AND IONOSPHERIC DISTURBANCES. T.R.Hartz.
Canad. J. Phys., Vol. 37, No. 10, 1137-52 (Oct., 1959).

The generation mechanism for the ionization irregularities in the upper atmosphere which are responsible for radio star scintillations is considered. The general belief that scintillations are related to the spread-F phenomenon observed on ionosonde recordings is found to be an inadequate explanation for the scintillations at 53 Mc/s recorded at Ottawa. An examination of the Ottawa recordings shows that there is a definite association, both in time of occurrence and geographical location, with those ionospheric disturbances that are usually considered to be due to incoming solar particles. Since other workers at more southerly geomagnetic latitudes have associated their scintillation observations with the spread-F phenomenon which they consider to be independent of auroral activity, it would appear that two mechanisms, at least, are responsible for the radio star fluctuations: namely, the precipitation of solar corpuscles and a mechanism linked with the spread-F phenomenon. The former seems to predominate at high latitudes, the latter is probably predominant at low latitudes, while both mechanisms probably are operative in middle latitudes.

551.5

775 RECOMBINATION IN THE IONOSPHERE DURING AN ECLIPSE. D.R.Bates and M.R.C.McDowell.
J. atmos. terrest. Phys., Vol. 10, No. 2, 96-102 (Feb., 1957).

Calculations are carried out to determine how the electron concentration in a layer in which there are two species of ion, with different recombination coefficients, varies during an eclipse. The variation exhibits several features of interest. In particular, the minimum electron concentration is reached sooner after totality than it is in the case of a layer which decays to the same extent but which contains only one species of ion.

551.5

776 CALCULATION OF GROUP INDICES AND GROUP HEIGHTS AT LOW FREQUENCIES.
J.J.Gibbons and B.Ramachandra Rao.
J. atmos. terrest. Phys., Vol. 11, No. 3-4, 151-62 (1957).

The formula is derived from which the group index for normal incidence, including collision effect, can be easily computed as a function of μ and χ for frequencies below one megacycle. A set of curves can then be prepared from which the group height to be expected from a given electron density profile can be quickly determined by graphical methods.

551.5

777 ELECTRIC FIELD MEASUREMENTS IN THE STRATOSPHERE. C.G.Stergis, G.C.Rein and T.Kangas.
J. atmos. terrest. Phys., Vol. 11, No. 2, 77-82 (1957).

The electric field in the atmosphere from ground up to 90 000 ft was measured during a series of twenty balloon flights made in 1955 and 1956. The tests indicate that the electric field in the atmosphere, above the exchange layer, decreases monotonically with height up to the maximum height at which measurements were made. The measured values of electric field agree very well with the values calculated from conductivity data and the assumption of an approximately constant air-earth current density.

551.5

778 ELECTRIC FIELD MEASUREMENTS ABOVE THUNDERSTORMS.
C.G.Stergis, G.C.Rein and T.Kangas.
J. atmos. terrest. Phys., Vol. 11, No. 2, 83-90 (1957).

The electric field and conductivity of the atmosphere were measured above thunderstorms in the central Florida area in a series of twenty-five balloon flights made at altitudes ranging from 70 000 to 90 000 ft above sea level. These tests indicate that at these altitudes and for the storms investigated there is a positive current of approximately 1.3 A, on the average, flowing upward from the top of the thunderstorm toward the ionosphere and confirm Wilson's hypothesis that thunderstorms are the generators which supply the electric current necessary for maintaining the earth's negative charge.

551.5

779 MOMENTUM SPECTRUM OF THE VAN ALLEN RADIATION. H.Alfvén.
Phys. Rev. Letters, Vol. 3, No. 10, 459-60 (Nov. 15, 1959).

It can be shown that when charged particles are injected into a variable magnetic field, their momentum spectrum is given by $N = \text{const. } p^{-n}$ where $2 < n < 3$ usually. Cosmic radiation has a power law of this type with $n = 2.6$, and it is now pointed out, that the Van Allen radiation exhibits a closely similar momentum spectrum. From this, it appears that the particles in the radiation belts are accelerated by variations in the earth's magnetic field.

H.J.A.Chivers

551.5

780 THE EQUILIBRIUM OF IONIZATION IN THE ATMOSPHERE AND NUCLEAR COMBINATION COEFFICIENTS.
P.J.Nolan.
J. atmos. terrest. Phys., Vol. 9, No. 5-6, 295-303 (1956).

The problem of ionic equilibrium in the atmosphere is reviewed and an explanation suggested for the equilibrium formula which involves the square root of the nucleus concentration. A method of estimating the combination coefficients of charged and uncharged nuclei by means of the Smoluchowski and Whipple formulae is given. The limits of validity of certain approximations in equilibrium formulae are discussed.

551.5

781 THE SMALL-ION CONCENTRATION AND SPACE CHARGE NEAR THE GROUND. C.J.Adkins.
Quart. J. Roy. Meteorol. Soc., Vol. 85, 237-52 (July, 1959).

A series of detailed measurements was made of the concentration of small ions near the ground. It was found that for values of the atmospheric potential gradient exceeding some $\pm$ 500 Vm^{-1} the electrode effect in the small ions was readily observable, and that when rain fell in a large electric field, there took place a large production of ions of sign opposite to that of the field. The latter effect was examined in some laboratory experiments which showed that the release of charge in the form of ions was associated with splashing. The mechanism by which the ions were produced was found and a determination made of the dependence of the charge released by individual drops on the field, drop mass and drop speed at impact. To determine the importance of the charge released by splashing at the ground, another series of observations was made including the measurement of space charge. It was found that in fine weather the field was sometimes controlled by clouds of charge near the ground. In disturbed weather natural point discharge gave rise to considerable values of the space charge, and in comparison with these, the charges produced by the splashing of rain only became important during heavy rain.

551.5

782 ATMOSPHERIC HELIUM. D.R.Bates and M.R.C.McDowe
D.R.Bates and M.R.C.McDowell.
J. atmos. terrest. Phys., Vol. 11, No. 3-4, 200-8 (1957).

Calculations are carried out on the escape of helium, using a less crude model of the thermosphere than did earlier workers. Low rates are obtained. It is found that He^4 atoms could not escape as rapidly, as they are apparently being released from the crust, unless the temperature at the base of the exosphere were higher than seems possible from consideration of the heat balance in the thermosphere or seems consistent with the number of He^3 atoms present. The hypothesis that escape occurs during occasional brief intervals of enhanced solar emission is found to be difficult to accept. A solution to the basic problem does not appear to be provided by invoking aurorae, solar gas or interplanetary dust. The validity of the customary assumption that atmospheric helium is in equilibrium is queried.

551.5

783 THE EFFECT OF RADIATION EXCHANGE ON THE CONVECTION IN A POLYTROPIC ATMOSPHERE.
K.H.Böhm and E.Richter.
Z. Astrophys., Vol. 48, No. 4, 231-48 (1959). In German.

The convective instability of difference perturbations in a plane parallel atmosphere with a strong density variation is investigated including the effects of radiation. The variability of the absorption coefficient κ as a function of temperature and density is taken into account. The instability of a disturbance of wavelength λ (expressed as a fraction of the zone thickness z_0) depends on: the ratio γ of the specific heats; the exponents ν and ι, describing the temperature and density dependence of the opacity and a dimensionless number C, the ratio of the time of free fall through the convection zone and the relaxation time for radiation crossing the zone. The eigenvalue problem, determining the "instability" as a function of the wavelength of the perturbation, has been solved numerically for about 50 different cases assuming κ proportional to the gas pressure. In this case the wavelength of maximal instability varies as $C^{0.225}$. For $C = 7.65 \times 10^{-3}$ this wavelength is slightly smaller than the zone thickness, and is 320 km for the upper part of the solar convection zone by calculation.

551.5

784 THERMAL EQUILIBRIUM IN THE ATMOSPHERE. G.V.Gruza.
Izv. Akad. Nauk SSSR, Ser. geofiz., 1958, No. 4, 564-5. In Russian. English summary: PB 141042T-5, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

Thermal equilibrium occurs when q, the vertical turbulent heat flow is zero. It is usually assumed that in the turbulent heat exchange the turbulent eddies transport the average potential temperature of the level of origin, but this is not valid in general. It is shown that conclusions based on the transfer of the average potential temperature are still valid when temperature pulsations are present. The replacement of γ_a, the dry adiabatic temperature gradient, by β, the equilibrium gradient, in the equation

$$q = -\rho c_p k\left(\frac{\partial \bar{T}}{\partial z} + \gamma_a\right)$$

as suggested by Budyko and Yudin (1946) is discussed, and it is stated that, though $(\gamma_a - \beta)$ may be an essential factor in nonequilibrium conditions, β does not have the sense of an equilibrium gradient. It is concluded that it is expedient to formulate the condition for thermal equilibrium either as an equality of the temperature and the dry adiabatic gradients, or as the constancy of the potential temperature with height. S.Weintroub

551.5

785 MEASUREMENT OF ATMOSPHERIC RADIATION BY A BLACK BALL. F.Möller.
J. Meteorol., Vol. 16, No. 1, 87-90 (Feb., 1959).

According to Gergen [Abstr. 7862 of 1956 and J. Meteorol., Vol. 14, No. 6, 495-504 (1957)] the difference θ_r between the temperature T_r of the black ball and the air temperature T_a is proportional to $\frac{\partial T_a}{\partial t}$ the time rate of change of T_a. His measurements on a layer of some km under and over the tropopause show that θ_r is greater than and less than zero in the summer and winter respectively in contradiction with theory. The author shows that the contradiction occurs because θ_r and $\frac{\partial T_a}{\partial t}$ are strictly proportional only when the atmosphere is a grey absorber, whereas an atmosphere consisting of water vapour and CO_2 is far from grey for i.r. radiation. The differences which result are discussed quantitatively with reference to Gergen's measurements. S.Weintroub

551.5

786 THE RAYLEIGH SCATTERING CORRECTION IN MEASUREMENTS OF THE SODIUM TWILIGHT FLASH. T.M.Donahue.
J. atmos. terrest. Phys., Vol. 9, No. 5-6, 262-8 (1956).

Sunlight at the wavelength of the D lines is attenuated by passage through the sodium layer before it is scattered by the lower atmosphere in twilight. Thus the use of the scattered intensity at another wavelength to correct for Rayleigh scattering will lead to an overcompensation. This effect increases for decreasing angles of solar depression and may lead to negative values for the twilight flash intensity. Calculations are presented for a standard detector and for a resonance detector consisting of a sodium vapour cell and a photomultiplier tube.

551.5 : 535.8

SEARCHLIGHT FOR ATMOSPHERIC SCATTER AND EXTINCTION MEASUREMENTS. See Abstr. 171

551.5

787 INTENSITY RATIO OF THE D_1, D_2 LINES OF SODIUM EMITTED IN THE UPPER ATMOSPHERE AT TWILIGHT AND DURING THE NIGHT. Nguyen-huu-Doan.
C.R. Acad. Sci. (Paris), Vol. 249, No. 5, 739-41 (Aug. 3, 1959). In French.

Interferometric observations of the sodium airglow made from Nov. 1958 to Feb. 1959 at Haute Provence, S.France give an intensity ratio (I_{D_2}/I_{D_1}) during the night of 1.9, near to that predicted by the respective transition probabilities. Lower values are found in morning and evening twilight (1.6 and 1.4 respectively), the decrease being attributed to auto-absorption in the atmospheric Na layer. D.R.Barber

551.5

788 ON THE ELECTROPHOTOMETRIC INVESTIGATION OF THE ILLUMINATION OF THE NIGHT SKY.
L.G.Bol'shakova, Yu.N.Georgievskii, A.N.Otto and S.F.Rodionov. Izv. Akad. Nauk SSSR, Ser. geofiz., 1958, No. 8, 1044-7. In Russian. English summary: PB 141042T-6, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

Constructional and operational data are given for a photoelectric recording photometer, incorporating a cooled photomultiplier with Cs–O cathode. It was designed specifically for I.G.Y. research on temporal variations of the infrared night airglow. Some laboratory methods for the accurate evaluation of the instrumental parameters required for precise calibration of the photometer are described. In one series of field experiments, parallel observations were made with similar apparatus at two high-altitude stations (2200 and 3900 m) on the Elbrus to test the influence of atmospheric transparency in the 1 μ region on night-sky illumination. Results indicated that the light was weakened in passing through the stratum of air 700 m thick by a factor of between 2.5-3. It was found also that the irregular short-period fluctuations of intensity observed at 2200 m almost disappeared at 3900 m. D.R.Barber

551.5

789 NIGHTGLOW OBSERVATIONS AT ÅS [NORWAY] DURING THE I.G.Y. G.Kvifte.
Geofys. Publ., Vol. 20, No. 12, 15 pp (1959).

A grating spectrograph with linear dispersion 35 and 50 A/mm (dependent on grating and spectral order) was used in the study of night airglow in the spectral range from 5100 to 7300 A. Apart from the forbidden OI lines and the NaI doublet, the NI(5200 A) doublet, the red NII forbidden lines (6548/83 A) and a sharp H_α line seem to be permanently present in the nightglow. A covariance of the intensities of the NII and the H_α lines, possibly also with OH bands, is reported. The (0,0) and (0,1) bands of the N_2^+ negative system were observed in the 4th order spectrum superposed on the 3rd. Accurate wavelengths of 8 OH bands in the visible region are given. From these, and previously published data, rotational energy levels for the vibrational states v = 0 to 9 of the OH $X^2\Pi$ state were computed. Absolute intensities of 4 OH bands are estimated. The rotational temperature, derived from OH bands (6,1) and (9,3), is found to be 215° K.

551.5

790 A SPECTROPHOTOMETRIC INVESTIGATION OF THE AIR AFTERGLOW. D.T.Stewart.
J. atmos. terrest. Phys., Vol. 10, No. 5-6, 318-19 (1957).

The spectral energy distributions of the yellow-green afterglow produced by a discharge in air, and of a similar continuum produced by mixing nitric oxide and atomic oxygen, have been measured. They were found to be identical, and have a short wavelength limit at 3700 A, providing further evidence that the continuum in both cases can be attributed to the nitrogen dioxide molecule.

551.5

791 STUDIES ON THE EXCITATION OF AURORA BOREALIS. I. THE HYDROGEN LINES. A.Omholt.
Geofys. Publ., Vol. 20, No. 11, 40 pp. (1959).

Full details are given of the design and performance of a new split-beam photoelectric filter photometer used to measure intensities of auroral H_β (4860 A), and N_2^+ (4709 A) emission features. Measurements made in Tromsø, Norway, during the period February to March 1958, showed the intensity ratio, I_{4860}/I_{4709}, to be usually < 0.1. H_β emission was absent in homogeneous arc, and pulsating rayed-band displays (for low-latitude aurorae, H_β is always present in arcs, but weak or absent in active rayed forms). It is computed that the total influx of particle energy required to maintain an aurora of brightness III (international scale) in the zenith is

$\sim 6 \times 10^{13}$ eV cm^{-2} sec^{-1}. The role of auroral protons is also discussed. It is evident that they cannot regularly initiate the main excitation for any of the recognised types of aurorae, although it has not yet been possible to derive the absolute proton flux.

D.R.Barber

551.5

792 $H\alpha$ EMISSIONS DURING AURORAE OVER WEST-CENTRAL CANADA. R.Montalbetti and A.V.Jones.
J. atmos. terrest. Phys., Vol. 11, No. 1, 43-50 (1957).

Observations of the occurrence of the $H\alpha$ line in auroral spectra obtained at Saskatoon and at Churchill are reported. These observations are discussed with particular reference to the auroral theory of Martyn. The diurnal dependence of the $H\alpha$ emission does not seem to be in agreement with this theory. The dependence of $H\alpha$ intensity on latitude and magnetic disturbance index suggests that the zone of maximum proton precipitation moves southwards as the magnetic disturbance becomes more intense. This observation is consistent with Martyn's theory, and also with Störmer's theory and other theories derived from Störmer's analysis.

551.5

793 AURORAL ISOCHASMS. B.Hultqvist.
Nature (London), Vol. 183, 1478-9 (May 23, 1959).

Vestine's observational isochasms (Abstr. 729 of 1945) disagree quite considerably in the region of N.E. America with theoretical isochasms calculated by the author (Abstr. 6383 of 1959) as projections of circles in equatorial plane outside the Earth onto its surface along the geomagnetic lines of force. However, recent observations carried out by Gartlein during the I.G.Y. (Visual Observations, News Letter No. 18, Ithaca, New York, Feb. 23, 1959) yield isochasms which agree well with theory. F.Lachman

551.5

794 RESULTS OF AURORAL OBSERVATIONS AT TROMSØ AND OSLO FOR THE FOUR WINTERS 1953-54 TO 1956-57. L.Vegard, S.Berger and A.Nundal.
Geofys. Publ., Vol. 20, No. 9, 36 pp.(1958).

A detailed discussion (with illustrations) of 155 auroral spectrograms taken with specially-designed spectrographs at the Auroral Observatory, Tromsø, and the Physical Institute, Oslo,between 1953 and 1957. Temperature measurements, using the R-branch rotational components of the negative N_2^+ bands gave a mean ionospheric temperature, from high, and low altitude spectra, of 305°K, with no clear indication of an increase of temperature with height between 100 and 500 km. The true temperature corresponding to that expected from spectrograms with sufficiently high dispersion would be ~ 220°K. D.R.Barber

551.5

795 THE ZENITH-ANGLE DISTRIBUTION FUNCTION OF AURORAL PROTONS. B.A.Bagariatskii.
Astron. Zh., Vol. 35, No. 3, 495 (1958). In Russian. English translation in : Soviet Astron—AJ (New York), Vol. 2, No. 3, 453 (May-June, 1958).

Points out that the distribution function used in Abstr. 9085 (1959) is identical with that proposed by Chamberlain (Abstr. 12915 of 1959).

551.5

796 LOW-FREQUENCY RADIO EMISSION FROM AURORAE. G.R.Ellis.
J. atmos. terrest. Phys., Vol. 10, No. 5-6, 302-6 (1957).

This paper discusses the possibility that Cherenkov radio emission by auroral particles approaching the earth may contribute to the level of the continuous component of atmospheric radio noise observed at frequencies of hundreds of kilocycles per second. It is shown that, provided the Cherenkov process is valid at radio frequencies, the flux density of the radiation may be as high as 10^{-21} W m^{-2}(c/s)$^{-1}$ at these frequencies, well above the minimum observable using current techniques. The frequency range of the emission would extend from a few hundred kc/s to low audio frequencies.

551.5

797 RADIO REFLECTIONS FROM AURORAE. III. THE ASSOCIATION WITH GEOMAGNETIC PHENOMENA. K.Bullough, T.W.Davidson, T.R.Kaiser and C.D.Watkins.
J. atmos. terrest. Phys., Vol. 11, No. 3-4, 237-54 (1957).

For Pt II, see Abstr. 5807 (1955). This paper presents a further study of the radio-echo observations of auroral ionization, made on a frequency of 72 Mc/s between June 1949 and October 1953. These data are compared with observations made at Eskdalemuir. A good correlation is found between the daily frequency distribution of the radio echoes and the mean daily variation in magnetic disturbance The change from a positive to negative bay type of disturbance tends to occur between 2100 and 2200 hr local time and coincides with a minimum in the frequency of echo occurrence. The occurrence of radio echoes corresponds with features in the magnetic disturbance. The probability of occurrence of 72 Mc/s echoes during a positive disturbance is approximately double that for a negative one, being 50 per cent for $\Delta H > 100\ \gamma$ and $\Delta H < -200\ \gamma$. The results and conclusions appear to conflict with the Chapman–Ferraro–Martyn theory of magnetic storms and aurorae.

551.5

798 RADAR ECHOES FROM THE AURORA. V.I.Pogorelov.
Izv. Akad. Nauk SSSR, Ser. geofiz., 1958, No. 8, 1048-51. In Russian. English summary : PB 141042T-6, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

Radar echoes from the aurora observed as part of the I.G.Y. programme at Roshchino were (a) stationary or very slowly moving or (b) rapidly moving. Analyses of the former gave the height of most probable reflection as 120 km. The latter appeared to be due to interference from another radar. R.W.Nicholls

551.5

799 ON THE CONNECTION BETWEEN THE AURORAL LUMINOSITIES AND THEIR RADAR REFLECTIONS. F.E.Martel' and V.I.Pogorelov.
Izv. Akad. Nauk SSSR, Ser. geofiz., 1958, No. 8, 1052-3. In Russian. English summary: PB 141042T-6, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

Correlation between radar reflections from and photographic studies on the aurora from Roshchino lead to the conclusions: (a) The most intense radar reflections coincide with clearly defined auroral streamer displays; (b) Reflections of large amplitude correspond to bright aurorae; (c) There is a small dispersion (5°-10°) between the azimuths of the most intense parts of the aurora and the azimuths of the most intense radar reflections. R.W.Nicholls

551.5

800 THE RED AND NEAR-INFRA-RED AURORAL SPECTRUM. A.Omholt.
J. atmos. terrest. Phys., Vol. 10, No. 5-6, 320-31 (1957).

Six auroral spectra covering the wavelength range 5400-8800 A have been subject to thorough intensity measurements. The intensity distributions in the First Positive band system and the Meinel band systems were measured and related to theoretical data. The altitude variations of these band systems and the strongest oxygen lines and bands were studied, the intensity ratio between the red [O I] lines λ6300/64 and the First Positive bands being taken as an indication of relative altitude. An auroral feature detected at 7325 A on spectra from high altitudes is tentatively identified as the [O II] multiplet $^2D–^2P$. The intensity distribution and its variation with altitude are briefly discussed.

551.5

801 MEASUREMENTS OF THE ABSOLUTE INTENSITY OF THE AURORA AND NIGHT AIRGLOW IN THE 0.9-2.0 μ REGION. A.W.Harrison and A.V.Jones.
J. atmos. terrest. Phys., Vol. 11, No. 3-4, 192-9 (1957).

Absolute intensity measurements have been made at Saskatoon of the bands of $\Delta v = 2$ and $\Delta v = 3$ sequences of the OH vibration–rotation bands of the night airglow. The relative intensities are in reasonable agreement with the calculations of Heaps and Herzberg (1952). The rate of production of OH molecules excited to the ninth vibrational level was estimated from the intensity of the 4,2 band to be 15×10^{11} molecules/cm^2 column sec. Spectra of the aurora in the 0.9 μ-2.0 μ region have been obtained with a spectrometer employing a PbS cell detector. The spectra show several new bands of the Meinel N_2^+ system and a strong emission at 1.04 μ to which both the 0,0 1PG N_2 band and the ^2P-^2D NI doublet probably contribute Absolute intensity measurements of the infrared auroral bands are in reasonable agreement with estimates based on extrapolations from bands at shorter wavelengths.

551.5

802 THE VERTICAL ELECTRIC CURRENT DURING CONTINUOUS RAIN AND SNOW. J.A.Chalmers.
J. atmos. terrest. Phys., Vol. 9, No. 5-6, 311-21 (1956).

Measurements have been made of the total vertical current reaching the ground during continuous rain and snow. In rain the current is nearly always positive, in snow negative. When the current is related to the potential gradient, the results for rain and snow are represented by two lines which are nearly parallel but are quite widely separated. Attempts are made to account for the results and the processes of charge separation are discussed.

551.5

803 THE RADAR OBSERVATION OF LIGHTNING. M.G.H.Ligda.
J. atmos. terrest. Phys., Vol. 9, No. 5-6, 329-46 (1956).

A series of observations of radar echoes from lightning discharges detected on a horizontally scanning system are reported. The investigation has comprised the development of a practical and convenient method of studying many properties of high-level strokes. Also described are the methods of observation used, the physical, geometrical and meteorological factors involved, and the resulting interpretations. A photograph of the echo from a discharge over 100 miles in length is shown, as well as many others exhibiting novel or interesting characteristics.

551.5

804 RADAR OBSERVATIONS OF LIGHTNING ON 1.5 METRES. J.L.Pawsey.
J. atmos. terrest. Phys., Vol. 11, No. 3-4, 289-90 (1957).

Very early observations on 1.5 m of echoes from lightning flashes are described. Approximate values for the echo cross-section, (≈ 40 m^2), duration ($\approx \frac{1}{4}$ sec) and horizontal extent (several miles) are given. The associated atmospherics are also described.

BIOPHYSICS · PHYSIOLOGICAL PHYSICS

574

805 THE BIOLOGICAL SYSTEM AS A "STATIONARY OPEN SYSTEM" AFTER THE THEORETICAL MODEL OF L.VON BERTALANFFY. R.Morchio.
Nuovo Cimento Suppl., Vol. 12, No. 1, 100-19 (1959). In Italian.

A very general account of the way in which thermodynamics may be applied to the type of open system met with in biology; emphasis is laid on the fundamental concepts rather than the mathematics. J.M.Hough

Hearing . Speech

599.3 : 534.83

806 NOISE STRESS IN LABORATORY RODENTS. I. BEHAVIORAL AND ENDOCRINE RESPONSE OF MICE, RATS, AND GUINEA PIGS. A.Anthony, E.Ackerman and J.A.Lloyd.
J. Opt. Soc. Amer., Vol. 31, No. 11, 1430-7 (Nov., 1959).

Mice, rats, and guinea pigs were exposed daily to high intensity noise in the frequency range of 150-4800 c/s at a sound pressure level of 140 dB, re 0.0002 μbar. It was found that the behavioural and endocrine responses differ in the three species studied. The adrenal response of animals exposed to noise supports the interpretation that noise acts as a physiological stress, but does not induce harmful extra-auditory effects. Thus, the endocrine system appears to act as a multiloop feedback system which compensates for the effects of noise on the central nervous system.

599.3 : 534.83

807 NOISE STRESS IN LABORATORY RODENTS. II. EFFECTS OF CHRONIC NOISE EXPOSURES ON SEXUAL PERFORMANCE AND REPRODUCTIVE FUNCTION OF GUINEA PIGS. A.Anthony and J.E.Harclerode.
J. Acoust. Soc. Amer., Vol. 31, No. 11, 1437-40 (Nov., 1959).

Chronic exposure of male guinea pigs to intense, low-frequency noise (139-144 dB, 300-4800 c/s) for six weeks did not affect their sexual performance. Histological and histochemical analyses of various organs indicated noise is followed by increased activity of the adrenal glands. However, the absence of pathology in the reproductive and digestive organs indicated that the tolerance limits of animals were not exceeded.

612.7

808 NUMBER OF AXIS CROSSINGS AND THE INTELLIGIBILITY OF SPEECH. J.W.Black and W.C.Hixson.
J. Acoust. Soc. Amer., Vol. 31, No. 10, 1384-5 (Oct., 1959).

These were determined experimentally and the correlation between the two quantities was inconclusive. H.D.Parbrook

612.7

809 RESULTS OBTAINED FROM A VOWEL RECOGNITION COMPUTER PROGRAM. J.W.Forgie and C.D.Forgie.
J. Acoust. Soc. Amer., Vol. 31, No. 11, 1480-9 (Nov., 1959).

As an initial step toward a general speech recognition computer programme, a programme was developed to recognize ten English vowels in isolated words of the form |b|-vowel-|t|. The input to the computer was real-time spectral data. The programme first determined the rough location of the first two formants. The remaining confusions were resolved by (1) finer determination of the F1 and F2 locations by the use of slope and/or valley information; (2) the use of pitch information, and (3) in certain cases the determination of the position of F3. The over-all score for 21 subjects (11 male and 10 female) was 88%. By the use of duration information, the score was raised to 93%.

612.7

810 MINIMAL RULES FOR SYNTHESIZING SPEECH. A.M.Liberman, F.Ingemann, L.Lisker, P.Delattre and F.S.Cooper.
J. Acoust. Soc. Amer., Vol. 31, No. 11, 1490-9 (Nov., 1959).

It has been found to be extremely difficult to isolate phonemic elements from recorded utterances or to synthesize speech by assembling prerecorded phonemic segments. One reason for the difficulty lies in the fact that the preceptually discrete phonemes are typically combined, and in some cases encoded, into units of essentially syllabic dimensions. As a result, prerecorded elements must, in many cases, approximate syllables, and the synthesis of speech by this means will require a large inventory of recordings. By taking advantage of knowledge about the acoustic cues for synthesis in terms of phonemes (rather than syllables) and thus reduce considerably the number of separate rules or items needed. Indeed, one can reduce the number of rules still further by writing them at the level of subphonemic dimensions, viz., place and manner of articulation. Several complicating factors make it impossible to achieve an ideal minimum. First, rules or rule modifiers must be added to take care of certain prosodic and positional variations. Failure to do so not only affects naturalness, but also impairs intelligibility, even at the level of segmental phonemes. Second, it is necessary in a few special cases to have different rules for a single consonant phoneme (or a dimension of that phoneme) before different vowels. This reflects the occasionally complex relation between phoneme and articulation on the one hand and sound output on the other; presumably, this complication would not affect the rules of synthesis for an articulatory model. A system of rules for synthesis framed largely in terms of subphonemic dimensions is described with reference to an example. Words and sentences of rather high intelligibility have then synthesized by such rules.

612.7

811 MESSAGE UNCERTAINTY AND MESSAGE RECEPTION. I.Pollack.
J. Acoust. Soc. Amer., Vol. 31, No. 11, 1500-8 (Nov., 1959).

The fundamental principle of language engineering — namely, that the probability of a correct message reception is critically dependent upon the size of the set of messages available for communications — was examined experimentally. Accuracy of message reception was found to be independent of the message-source uncertainty but critically dependent upon the response uncertainty — or more exactly, upon the size of the set of relevant response categories. Implications for a conceptual model of the listener's behaviour are suggested.

612.7

812 MESSAGE REPETITION AND MESSAGE RECEPTION. I.Pollack.

J. Acoust. Soc. Amer., Vol. 31, No. 11, 1509-15 (Nov., 1959).

The improvement in word intelligibility associated with successive presentations of a word in noise was examined with recorded and with independent samples of the speech and/or its background noise. The listener's criterion for termination of a trial was shown to be a crucial determinant of the gain of intelligibility with successive presentations. The improvement in intelligibility was greater for independent samples of speech and noise than for successive presentations of a single recorded sample. The observed improvement, however, was less than predicted for the ideal observer with perfect memory by the theory of signal detectability. Indexes of response discriminability and signal discriminability are briefly discussed.

612.8

813 SCALING HUMAN REACTIONS TO THE SOUND FROM AIRCRAFT. K.D.Kryter.

J. Acoust. Soc. Amer., Vol. 31, No. 11, 1415-29 (Nov., 1959).

Studies were undertaken to determine how "noisy" commercial jet aircraft will sound to people on the ground in comparison to present-day commercial aircraft with reciprocating engines. Three experiments involved the flyover sound made by reciprocating-engine aircraft (a DC-7 and a Super-Constellation) and jet aircraft (a Caravelle, a Comet, and a 707). People were asked to judge the "annoyance" or potential bothersomeness of the sounds relative to one another. It was found that the over-all sound pressure level ("C" scale) and the speech interference level (SIL) of the sounds from the aircraft as measured on the ground, either outdoors or indoors, bear little relation to the judgments. The loudness level in phons, the values obtained with the aid of the "equal listener-response curve" of Miller and Beranek, and over-all sound pressure level "A" scale and "P" scale correlate better with the findings. However, the results of the judgment tests are predicted best when the SPL's of the various octave bands are weighted in a newly prescribed manner. This calculation scheme is based on previously published equal-annoyance contours and the procedures developed by Stevens for calculating loudness level.

612.8

814 DETECTION OF A PULSED SINUSOID IN NOISE AS A FUNCTION OF FREQUENCY.

D.M.Green, M.J.McKey and J.C.R.Licklider.

J. Acoust. Soc. Amer., Vol. 31, No. 11, 1446-52 (Dec., 1959).

The detectability of a pulsed sinusoid (0.1 sec) in white noise was measured at sixteen frequencies ranging from 250 to 4000 c/s. The measurements are compared with the results previously obtained from experiments in which continuous sinusoids of indefinite duration were used. The dependence of detectability on frequency appears to be very similar in all the experiments. The detectability of compound signals, i.e. signals with 12 and 16 sinusoidal components, was also measured. A comparison of the detectability for the single and combined sinusoids allows the approximate determination of how the auditory system sums energy over frequency.

Vision

612.8

815 COLOR NAMING EXPERIMENTS AND THE TWO-QUANTA THEORY. F.H.C.Marriott.

J. Opt. Soc. Amer., Vol. 49, No. 10, 1022 (Oct., 1959).

A new series of colour-naming experiments confirms Bouman and Walraven's data (Abstr. 1391 of 1958). The present author concludes that both the old and the new data are inconsistent with the view that only two light quanta are required to elicit a coloured or colourless response, but that 8-10 are required. R.A.Weale

612.8

816 RESEARCH TILTING HAPLOSCOPE. H.A.Knoll.

J. Opt. Soc. Amer., Vol. 49, No. 12, 1176-9 (Dec., 1959).

Exact knowledge of binocular coordination in human subjects has been obtained largely with the head held erect and with the fixation point symmetrically placed before the eyes in a horizontal plane. Rotational responses (vergences and versions) have been assumed to correspond with the rotational stimuli. The exceptions to these restrictions are reviewed. A tilting haploscope has been designed and constructed which differs from other haploscopes previously described in that: (1) it enables one to tilt the plane of regard (the plane containing the centres of rotation of the two eyes and the fixation point) about the base line (the line connecting the centres of rotation of the two eyes); (2) the subjects head can be tilted about the base line; and (3) a means of recording rotational responses is provided. The optical and mechanical features are described as well as the method of positioning the subject's head. Preliminary results using five subjects suggest that the ACA ratio decreases when the plane of regard is elevated, and that the ACA is not effected by the tilt of the head. Rotation of the eye lags the stimulus increasingly as the stimulus is moved peripherally with maximum values up to approximately $\frac{1}{2}$ deg.

612.8

817 LEVEL OF LIGHT ADAPTATION AND THE HUMAN ELECTRORETINOGRAM.

W.R.Biersdorf and J.C.Armington.

J. Opt. Soc. Amer., Vol. 50, No. 1, 78-82 (Jan., 1960).

Deals with the effects of two adaptational variables upon the human electroretinogram. First, further investigation of a temporal increase in electroretinogram amplitude during light adaptation is reported. The effects of red and white test flashes were compared at several adaptation levels. The temporal increase was found only for high luminance adaptation levels and only for white test flashes. Second, the effects of constant luminance test flashes upon a wide range of adaptation levels were investigated. It was found that increasing levels of light adaptation produced decreases in the amplitudes of the components of the electroretinogram. Long latency components were affected by lower levels of light adaptation and to a greater extent than short latency components. The results are considered in relation to the duplicity theory and to the resting potential of the eye.

TECHNIQUE . MATERIALS

66

818 DESIGN OF GRADIENTLESS FURNACES. M.J.Laubitz.

Canad. J. Phys., Vol. 37, No. 10, 1114-25 (Oct., 1959).

Temperature distributions in cylindrical furnaces are discussed, and design data are given which permit the construction of short furnaces in which the temperature varies less than 0.5% along the central half of the length of the heater. Formulae are also given for the calculation of temperature distributions in conventional furnaces with uniformly wound heaters.

669

819 SOME IMPROVEMENTS IN THE METHOD OF PREPARING PURE SILICON BY THERMAL DECOMPOSITION OF SILANE. Ya.E.Pokrovskii, S.I. Kleshchevnikova and E.I.Rumyantseva.

Fiz. tverdogo Tela, Vol. 1, No. 6, 999-1001 (June, 1959). In Russian.

Describes and illustrates new apparatus for overcoming inadequacies found from experience with the earlier apparatus described by the authors in Abstr. 1463 (1959). D.E.Brown

669

820 THE EXTRACTION OF COPPER AND NICKEL FROM GERMANIUM. K.P.Tissen.

Fiz. tverdogo Tela, Vol. 1, No. 6, 1001-3 (June, 1959). In Russian.

Describes experiments showing that good extraction of an impurity with a high diffusion coefficient, copper or nickel, from germanium can be obtained by covering the sample with a rhodium layer followed by heat treatment. A nickel layer may be used in the case of copper extraction. Thermal treatment is in a graphite container at 10^{-6} mm Hg for nine hours with temperature held constant to $\pm 2^{\circ}$C. Four different processes are described and the Hall constant is shown as a function of temperature for three samples. D.E.Brown

LIST OF JOURNALS

The following list supplements the List of Journals to be published with the Index to Volume 62 (1959). Reprints of the List of Journals will be obtainable from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Electronic Radio Engr	Electronic and Radio Engineer Title changed to Electronic Technology [Electronic Technol.] with the issue dated January, 1960.
Electronic Technol.	Electronic Technology (Formerly: Electronic and Radio Engineer). Iliffe and Sons, Dorset House, Stamford Street, London, E.C.1.
Elektronische Rechenanlagen	Elektronische Rechenanlagen [Article reprinted in: Entwicklungsberichte der Siemens und Halske Aktiengesellschaft].
ForschBer. Landes Nordrhein-Westfalen	Forschungsberichte des Landes Nordrhein-Westfalen (Formerly: Forschungsberichte des Wirtschafts- und Verkehrsministeriums Nordrhein-Westfalen). Westdeutscher Verlag, Ophovener Strasse 1-3, Cologne.
Forschungsber. Wirtsch.-Verkehrsmin. Nordrhein-Westfalen	Forschungsberichte des Wirtschafts- und Verkehrsministeriums Nordrhein-Westfalen Title changed to: Forschungsberichte des Landes Nordrhein-Westfalen [ForschBer. Nordrhein-Westfalen].
J. nuclear Energy	Journal of Nuclear Energy From the beginning of 1959 this journal will be published in three parts: Reactor Science (Part A); Reactor Technology (Part B); Plasma Physics—Accelerators—Thermonuclear Research).
Power Engr	Power Engineer The Society of Power Engineers, Cleremont, Simla 4. Publication address: Bikener House, Shahjahan Road, New Delhi 2.
Publ. sci. Univ. d'Algér	Publications Scientifiques de l'Université d'Algér. Serie A (Algér-Mathématiques); Serie B (Algér-Sciences Physiques). Faculté des Sciences, L'Université d'Algér, 2 Rue Michelet, Algiers.
Reactor Sci.	Reactor Science (Journal of Nuclear Energy, Part A). Pergamon Press, 4 and 5, Fitzroy Square, London, W.1; 122 East 55th Street, New York 22, N.Y.
Res. Bull. Saugar Univ. Phys. Soc.	Research Bulletin of the Saugar University Physical Society Saugar, M.P. (India).
Tech. Mitt. B.R.F.	Technische Mitteilungen aus dem Betriebslaboratorium fur Rundfunk und Fernsehen (BRF). Agastrasse, Berlin-Adlershof.
Wood	Wood The Tothill Press, 33 Tothill Street, Westminster, London, S.E.1.
Telefunken Ztg	Telefunken Zeitung Address changed to: Telefunken GmbH, Ernst-Reuter-Platz, Berlin-Charlottenburg 1.

NEW JOURNAL

J. mech. Engng Sci.	Journal of Mechanical Engineering Science The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London, S.W.1. Quarterly. Vol. 1, No. 1 dated June, 1959.

ABSTRACTING JOURNALS

Associated Electrical Industries (Manchester)	Associated Electrical Industries (Manchester) Limited, Research Department Technical News Bulletin (Formerly: Metropolitan-Vickers Technical News Bulletin [Signature: Metropolitan-Vickers]). Trafford Park, Manchester 17.
Metropolitan-Vickers	Metropolitan-Vickers Technical News Bulletin Title changed to: Associated Electrical Industries (Manchester) Limited, Research Department Technical News Bulletin [Signature: Associated Electrical Industries (Manchester)] with issue dated January 1, 1960.
Science Abstracts of China	Science Abstracts of China (Mathematical and Physical Sciences; Chemistry and Chemical Technology; Biological Sciences; Earth Sciences; and Technical Sciences). The Institute of Scientific and Technical Information of China, 117 Chao Yang Men Street, Peking.

ERRATA

Abstr. 1814 (1952) line 4 : for "4798 (1950)" read "4798 (1949)".
Abstr. 3563 (1953) line 11 : for "Rh^{156}" read "Rh^{106}".
Abstr. 7864 (1955) line 2 : for "A.Luyckz" read "A.Luyckx".
Abstr. 1717 (1956) line 2 : for "Y.Hirschberg" read "Y.Hirshberg".
Abstr. 2488 (1956) line 3 : for "R.I.Hudson" read "R.L.Hudson".
Abstr. 5497 (1956) line 2 : for "S.B.Karmohapatra" read "S.B.Karmohapatro".
Abstr. 7482 (1956) line 2 : for "R.F.Chaudri" read "R.M.Chaudhri".
Abstr. 7681 (1956) line 2 : for "M.Govindree" read "M.Govinjee".
Abstr. 5406 (1957) line 2 : for "G.J.Batty" read "C.J.Batty".
Abstr. 5651 (1957) line 3 : for "P.Falk-Variant" read "P.Falk-Vairant".
Abstr. 6026 (1957) line 2 : for "H.Dallmann" read "H.Kallmann".
Abstr. 3699 (1958) line 2 : for "E.R.Caianello" read "E.R.Caianiello".
Abstr. 4847 (1958) line 3 : for "LINE" read "LENS".
Abstr. 6089 (1958) line 2 : for "R.M.Chaudri" read "R.M.Chaudhri".
Abstr. 661 (1959) line 2 : for "E.O.Hittmair" read "O.Hittmair".
Abstr. 1457 (1959) line 4 : for "I.B.Karpova" read "I.V.Karpova".
Abstr. 2169 (1959) line 3 : for "B.R.Ramachandra Rao" read "B.Ramachandra Rao".
Abstr. 3475 (1959) line 2 : for "M.Glisksman" read "M.Glicksman".
Abstr. 7682 (1959) line 12 : for "hydrogeneration" read "hydrogenation".
Abstr. 11807 (1959) line 3 : for "V.T.Telegdi" read "V.L.Telegdi".
Abstr. 11895 (1959) line 2 : for "I.I.Pomeranchuk" read "I.Ya.Pomeranchuk".
Abstr. 12885 (1959) line 4 : Journal reference should read "Izv. Akad. Nauk SSSR, Ser. geofiz., 1959, No. 4, 617-20".
Abstr. 13364 (1959) line 2 : for "W.Schaafs" read "W.Schaaffs".
Abstr. 13575 (1959) line 5 : for "Nacpaul" read "Nagpaul".
Abstr. 13666 (1959) line 3 : for "I.Ostroumov" read "V.I.Ostroumov".

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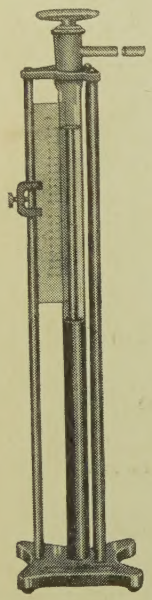

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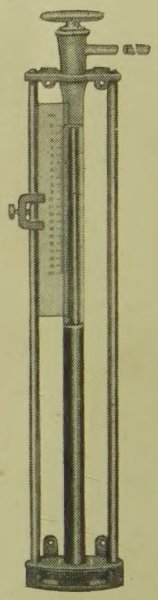

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